APPLICATION OF A MODIFIED ACTIVITY BASED COSTING METHOD IN AN INDUSTRIAL SETUP

by

SUDHIR S. KHERDE

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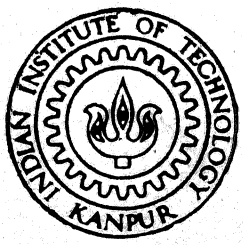

DEPARTMENT OF INDUSTRIAL AND MANAGEMENT ENGINEERING

INDIAN INSTITUTE OF TECHNOLOGY KANPUR

FEBRUARY, 1998

APPLICATION OF A MODIFIED ACTIVITY BASED COSTING METHOD IN AN INDUSTRIAL SETUP

A Thesis Submitted

in Partial Fulfilment of the Requirements

for the Degree of

Master of Technology

by

SUDHIR S. KHERDE

to the

DEPARTMENT OF INDUSTRIAL AND MANAGEMENT ENGINEERING

INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

FEBRUARY, 1998

CERTIFICATE

This is to certify that the present work entitled "**APPLICATION OF A MODIFIED ACTIVITY BASED COSTING METHOD IN AN INDUSTRIAL SETUP**" has been carried out by **Mr. Sudhir S. Kherde** (Roll. No. 9611410) under our supervision and that it has not been submitted elsewhere for a degree.

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23 February 1998

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Acknowledgements

I express my sincere gratitude to my guide Professor Arun P. Sinha who initiated me and helped in formulating the concept of the work. I owe my sincere thanks to Professor T.P.Bagchi who helped me in completing this work. I am grateful to both of them for their timely suggestions and encouragement at various stages of my work.

I am also thankful to the teachers of IME department for their kind guidance during my course work and during my thesis work.

I shall not spare from acknowledging the research scholars in the IME Department, Mr. Neeraj Kumar, Mr. Sanjeev Mishra and Mr. S.P.Singh whose suggestions helped me in my work and while their jokes kept me smiling as I tapped the keyboard.

I would like to thank all of my M.Tech. colleagues and all non-teaching members of the IME Family for their kind co-operation throughout my stay at the IIT Kanpur campus and making this time a memorable one.

I am also thankful to my wife Ms. Chhaya for her constant moral support during this work and my son Sajal for his cheerfulness that kept me alive.

SUDHIR S. KHERDE

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Abstract

Many companies continue to make pricing decisions on the basis of cost information provided by a traditional costing model commonly known as the "percentage mark-up on material" method. A recent improvement proposed here is the activity-based costing method. However, with the increasing share of overhead costs, the generally accepted accounting methods do not provide "correct" cost data in multi-product manufacturing companies that also suffer considerable idle times. In this work we propose a Modified Activity Based Costing method for the allocation of various departmental costs to the product. This methodology facilitates on-line costing and it does not assign idle capacity costs of the company to the product. Idle capacity costs are to be treated here separately and are shown as a separate entry in the profit and loss statement of the company. We tested this methodology on a Case Study of a medium sized manufacturing company in Kanpur. We found the costs of three different components used in the assembly of hydraulic pump manufactured by the business. Costs were obtained by three methods; the "Percentage Mark-Up on Material" method, the pure "Activity Based Costing" method and the proposed "Modified Activity Based Costing" method. It is noted that the proposed "Modified Activity Based Costing" method perhaps offers the most realistic cost of the components when compared to the other two methods. It is observed that the Activity Based Costing method shows higher product cost at lower capacity utilization when compared with the proposed method, while the "Percentage Mark-Up on Material" method severely distorts the cost picture altogether.

Chapter 1

INTRODUCTION AND LITERATURE SURVEY

With the increasing complexity of present day's manufacturing organization, where emphasis is on small batch or customized products, product costing plays an important role. Managers in these companies make important decisions about pricing, product mix and process on the basis of cost information. This cost information is the result of accounting choices made decades ago, when companies manufactured a narrow range of products. The cost of direct labor and material could be easily traced to individual products and happened to be prominent in total cost of product. Allocation of overheads to individual products by overhead rate calculated on the basis of direct labor cost or labor time or by direct material could not distort the product cost prominently. Direct labor now represents a small fraction of total cost of production while expenses covering production support operations, marketing, distribution, engineering, and other overhead functions have exploded. Most companies still allocate these rising overheads and support costs by direct labor base. This simplistic approach severely distorts the product cost. Erroneous product costing may drive us to take incorrect decisions. Studies have shown that the incorrect product costing shows many products in profit that are otherwise in loss [5].

The latest philosophy of "**Activity Based Costing**" has attempts to logically accumulate the cost of all supporting departments to the product, in the proportion, product demands that resource. This method produces precise and reliable cost data that can be used by managers to take variety of decisions.

1.1 Objective of Thesis

In this thesis we attempt to design a **"product costing model"** that is inspired by the philosophy of **"activity based costing"** and that would also help managers to compare the

performance between two different periods. This model will also help us to calculate variances from the set standards.

The model works on the principle that all costs of the manufacturing concern be allocated to the product **at each stage** of production and not only at the end of the product completion. Thus all inventories will also have the "fair share" of overhead and period cost. Period costs are those costs that are incurred for the period, examples of period cost would be insurance cost, interest cost etc. This model will be useful for "job work" type of manufacturing industries, and "multi-product" type of manufacturing industry.. This model distributes costs as production proceeds and is thus ready with total cost of production when production is complete. Idle time costs are treated as the cost of inefficiency in obtaining orders and not of production, and hence are not assigned to production. This costing model is constructed in the background of Kanpur Industrial Pumps Pvt. Ltd. Kanpur*. Kanpur Industrial Pumps manufactures a wide variety of industrial pumps and thus it may be charecterized as a "multi-product" manufacturing industry.

1.2 The Need for Accounting

Accounting is an information system designed to communicate financial information about a business firm. There are at least three kinds of accounting information which we categorize as follows

1. Information useful for managerial decision making.

Short term manegerial decision such as make or buy decision, acceptance of special orders, pricing are a few that require data regarding operations. These data include variable cost of production, present level of utilization, the present work load on facilities etc.

Long term decisions include decisions such as replacement or modernization of the facility, entering into new product line, investment in new machinery, continue or discontinue a particular product etc., These decisions require data regarding maintenance cost of machines, the availability of the machine, present rate of output of the machines, etc. Continue or discontinue the product require the true product cost of manufacturing, the competitive price of the product, etc. Competitive price is the least price one should offer to remain in highly competitive environment. Thus it must be at least equal to the variable cost of production.

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* The name of the company has been disguised to preserve anonymity.

2. Information useful for planning & control.

Decisions such as scheduling of jobs on machines, deciding a due date for the job, whether present level of one shift working is sufficient for meeting the heavy demand or we need to work on overtime, when should the raw material be purchased, what jobs are to be made and in what quantities are generally the elements of operational planning, this requires data on existing stock in store, in WIP, the expected time of doing the jobs on different machines, adjusting the preventive maintenance schedules, etc. On the cost front, what is the expected cost of doing any operation, how it can be reduced by changing the machine, process or design, what is the present rework or scrap level, whether it is due to a design complication or due to process characteristic are some of the planning and control issues that require data from management accounting.

3. Information useful for summery financial reporting.

The company's shareholders, government agencies such as registrar of companies, income tax department ministry of industrial development and other agencies are interested in the overall business of the company. This information is required to be submit as balance sheet and profit and loss accounts. Companies covered under cost audit rule have to submit in the pre-defined format, the cost audit reports.

Each of the three uses often requires data gathered from different source or using a different accounting model.

1.3 Users of Accounting Information

Receivers of accounting information can generally be classified in one of two broad categories.

1. Internal users

Internal users include owners of the company and managers who make decisions about the firm's operations.

2. External users

These include those who have transactions with the company such as individual creditors, bankers, suppliers etc. Besides, there are government agencies that do not have transactions but have authority to oversee that the business

A. Complies with the requirement of law relating to financial transactions, e.g. It pays required amount of tax, pays dividends to the shareholders out of profits, provide depreciation according to the prescribed norm etc.

B. Discloses its capital, profit, retained earning, sales and cost to the public at large.

C. Provides data relating to its borrowings so that future lenders are provided with the required information regarding the present level of borrowing etc.

A third category of external users consists of those who have neither any economic transactions nor concerned with regulation of business activities, these are labor union, stock brokers, trade associations etc.

Receiver of accounting data can be more effective in their jobs if they are made aware of how the data have been gathered and the principles upon which they are being reported.

1.4 The Growth of Costing

The increasing scale and growing complexity of business, and the administrative problems that resulted from these have proved the existing methods ineffective and demanded new costing procedures that would take into account the simplistic treatment of overheads generated due to the manufacturing and administrative complexity. Perhaps the most important factor, however, leading to a growth of interest in improving costing methods was the increasing difficulty of setting prices in the engineering industry. As the industry grew and as it became more competitive, the interest in cost accounting also developed.

A conventional costing system adds overhead to the prime costs (i.e. direct material cost + direct labor cost) of each job usually by adding a flat percentage for instance of labor cost. This percentage would be ascertained from the previous year's financial accounts by expressing the total overhead costs for the year as a percentage of the year's total direct wages.

The "percentage on prime cost" method is another variation of the above which regards all jobs with equal prime costs as being responsible for an equal amount of overhead. This, of course, was open to criticism on the ground that the cost of materials used on a job (an important part of its prime cost) might be no indication at all of the load that the job imposed on supervision, equipment and factory space, etc.

It is accepted by a number of writers that no single basis of overhead allocation is perhaps satisfactory. John Mann [6] argued for division of overhead cost into (a) buying costs which vary with the cost of goods bought, (b) selling costs which vary with the sales, and (c) production costs. Subsequently, some accountants started using machine-hour rates (see section 2.3) as a means of allocating those expenses which were directly associated with the machine, such as depreciation, machine maintenance and power.

Several newer factors have also forced managers to turn their attention to cost accounting. A primary reason is increased competition, which has led to more frequent review of pricing. Sharply competitive pricing requires rapid access to current information about costs from raw material all the way through the product's bill of material. Thus "Once a year" product cost building may be highly unsatisfactory for such situations [9].

In addition, the indirect cost associated with manufacturing process often rises more rapidly than direct product cost. The allocation of indirect cost on the basis of direct labor or material cost is becoming an unsatisfactory determinant. Many of these indirect costs are not proportional to direct labor or material used. As a result, companies have extremely high overhead rates and these rates tend to confuse rather than explain the reason for increased product cost.

No standardized cost accounting system can be used in all situations of manufacturing. All manufacturing setups are unique in their own way. Further the type of production system affect the design of costing system. Thus costing system for large batch mass production system cannot be used for small batch production system. Also size of the company, range of product and intended purpose of system influence the design of costing system.

Now we review the most commonly used conventional cost accounting methods and latest developments in the next section.

1.5 Generally Used Costing Methods

1.5.1 Distribution Costing

Distribution costing, a method conventionally used to allocate overheads, is based on the premise that all cost incurred with in a period must be allocated to the products produced.

It accumulates all overhead costs incurred during a specific time period and the overhead cost per product is often computed by dividing the total overhead for the period by the number

of products produced. However this approach results in a variable assignment of indirect costs as production volume and utilization of facilities fluctuate.

If the factory is operating at 70% of its full capacity, the cost of 30% (remaining idle capacity) of the facility is equally distributed to the products manufactured [20]. This would unnecessarily inflate the unit cost of manufacturing.

Distribution type costing technique can ideally be utilized only if plant is running at full capacity and all products produced are identical. Even if one condition is not satisfied, the method is bound to give unsatisfactory product cost. When a facility converts from one shift to two shifts the production increases and it will appear to have lowered the product unit cost. In reality, the product has consumed the same time of facilities, labor and material.

In multiple product case a percentage of direct labor or machine cost is conventionally added as a portion of overhead. This is again questionable because the accumulation of overhead may not be related to the direct labor or machine cost.

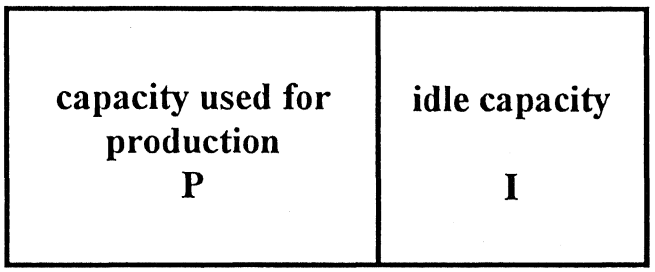

Fig: 1.1 Product costing in Distribution accounting

Fig. 1.1 above shows the facility that has idle capacity I, and utilized capacity with production P. If C is the overhead cost of whole facility, then in distribution costing

Overhead Per Unit = C/P

In this costing method all fixed costs, direct costs and variable costs are absorbed by WIP and finished goods inventory and in turn become part of inventory valuation, but "general administration" cost (this includes general management, accounting department, consultant's fees, technical library etc.) is ignored at the factory level. These costs are not included in the product cost and hence not inventoried. They are also known as "below the line" costs.

Emig & Mazeffa [10] have said that the distribution method also fails to recognize that product diversity drastically increases or distorts apparent overhead cost.

Brimson [3] recognized the fact that distribution costing does not penalize overproduction. He also hinted that idea of overhead being absorbed by production volume encourages companies to overproduce.

1.5.2 Direct Costing

In direct costing (another popular costing method), costs that enter inventory, include only the **variable cost of manufacturing** whether direct or indirect. Variable costs are costs that increase directly with the production quantity. **All period costs** are treated as non-inventoried i.e. "below the line" costs. This undervalues the inventory in work in process (WIP) and finished store.

The major application of direct costing is in break even analysis, which tries to answer 'what if ' type of questions. The following is the list of the kinds of questions and decisions to which direct costing statements may contribute information.

What will happen to profit if volume increases by say 10%? What will happen to profit if we increase the selling price by say 5%? How much additional volume do we need to cover additional fixed cost? Fig. 1.2 is the break even chart that graphically represents the relations among fixed cost, variable cost of production and sales realization of the product. The cost figures are given by direct costing.

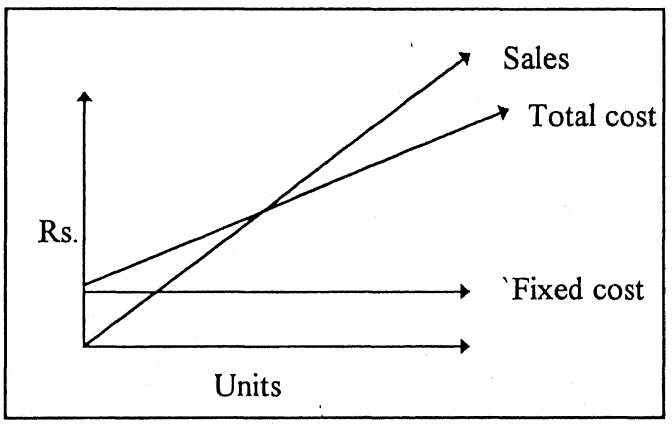

Fig: 1.2 Break even chart

One basic objective of direct costing is to provide a basis for incremental cost i.e. The additional cost required for increased production.

However direct costing does not attempt to accumulate product cost accurately. It also undervalues the inventory. Direct costing assumes that inventories produced in this period do not consume any fixed cost. Thus use of direct costing is limited only to short term decision. Comparison between different periods, for improvement of manufacturing efficiency, is not possible through direct costing.

1.5.3 Percentage Method of Costing

This is the most common method of allocating the overhead because it is simple and it can be accomplished manually. In this method a particular percentage of material cost is added to the cost of material as a share of labor and overhead. In this method no separate accounting for labor and other indirect material or labor is made. Thus if material costs Rs. 100 and percentage used is say 30% then at the completion of job it will cost Rs. 130, no matter what *process* it has undergone or what *indirect* material or labor it has demanded. Thus two products having same raw material cost will have same product cost. This method has lost its relevance with the introduction of computers and with the necessity of more precise cost calculation.

1.5.4 Activity Based Costing

Activity based costing (ABC) is one of the latest attempts to solve the costing problem [4]. The concept of activity based costing is "all of the company's activities exists to support the production and delivery of goods and services. They should therefore all be considered product costs". The process of tracing cost, first from resources to activities and then from activities to specific product, has to be done, ,even at the risk of some imprecision. Activity based costing uses the concept of 'cost driver' and attempts to separate value adding activities from non value adding activities.

This method categories the expense on the basis of unit level, batch level, product level and facility level activities [5]. Unit level activities are those that are proportional to the output in numbers. Thus machining time is a unit level activity. Batch level activities are those that are associated with the batch and not with the size of the batch. Material handling activity, lot inspection activity, setup time is a batch level activity. The efforts of R&D in product

development or use of special technology only for particular product is a product level activity. Other activities such as lighting, utilities or general maintenance of the building are categorized as the facility level activity.

Expenses related to only unit level, batch level and product level activities are assigned to the products. In activity based costing facility level expenses are kept at the plant level and not allocated to the product.

Activity based costing assigns cost of resources to the product according to the "cost driver". for example, material handling cost to product on the basis of number of handling required.

In a multi-product manufacturing situation where the products are well defined and activities related to the product is pre-defined, for example, what should be the material handling equipment used for particular product, what is its capacity etc., the use of activity based costing is appropriate. On the other hand situations in which activities cannot be pre-defined and documented, it is difficult to use activity based costing.

For example, take the case of Maintenance. This does not provide service to particular product but to certain machine which can be used to produce number of different parts. It is difficult to estimate the best cost driver for particular products. If the maintenance department is utilized for say 60% of its total capacity activity based costing does not take into account the cost of idle capacity and allocates all the cost to the product on the basis of pre-decided cost driver.

Activity based costing does not separate the cost of idle capacity of the resource required to produce the product. This idle capacity cost is also distributed over the products on the basis of cost driver. This makes the valuation of product volume dependent.

Activity based costing requires the data of total number of activities in a particular period; then it identifies the number of activities required for particular product and assigns the proportionate cost to the product [1]. This implies that cost of the product cannot be determined when product is made but at the end of pre defined accounting period. Activity based costing still treats general administrative cost as a 'below the line' costs and is production volume sensitive.

Summary of the usefulness of distribution costing, direct costing and activity based costing methods to support different managerial decisions is presented in Table 1.1.

	Distribution costing		Direct costing		ABC costing	
	Single product	Multi product	Single product	Multi product	Single product	Multi product
Product costing						
1) For under utilized capacity	Inaccurate (overvalued)	Inaccurate (overvalued or undervalued)	Not applicable	Not applicable	Overvalued	Overvalued
2) For full utilized capacity	Precise	Inaccurate (overvalued or undervalued)	Not applicable	Not applicable	Precise	Precise
Stock valuation						
1) For under utilized capacity	Inaccurate (overvalued or undervalued)	Inaccurate (overvalued or undervalued)	Does not consider fixed cost	Does not consider fixed cost	Overvalued	Overvalued
2) For full utilized capacity	Precise	Inaccurate (overvalued or undervalued)	Does not consider fixed cost	Does not consider fixed cost	Precise	Precise
3) WIP	Undervalued	Undervalued	Does not support	Does not support	Precise	Precise
Short term decisions						
1) Break even analysis	Does not support	Does not support	Support	Support	Does not support	Does not support
2) Accept an order	Does not support	Does not support	Support	Support	Support	Support
Long term decisions						
1) Continue or discontinue product	Does not support	Does not support	Does not support	Does not support	Supports	Supports
2) Effect of performance on cost	Does not support	Does not support	Does not support	Does not support	Supports	Supports
3) Helps in day today planning	Does not support	Does not support	Does not support	Does not support	Supports	Supports
Sensitive to volume	Yes	Yes	Yes	Yes	Yes	Yes
On line cost availability	Does not support	Does not support	Does not support	Does not support	Does not support	Does not support
Considers all cost	Does not support	Does not support	Does not support	Does not support	Does not support	Does not support

Table 1.1 The extent to which different costing methods support different managerial decisions.[20]

1.5.5 Other Methods

Machine labor costing was suggested by Schwazback and Vangermeersch [19]. The machine cost are broken into variable and fixed components and the standard and actual costs are calculated separately for each machine . Machine costs are charged to product on the basis of machine labor hours.

This method exercises good control over manufacturing overhead and stresses machine utilization. It also differentiates in machine hour costs based on type of machine. It uses departmental overhead allocation on the basis of machine hour rate but does not recognize general administration costs and WIP costs.

The productive hour rate costing, suggested by Ostwald [15], calculates the productive hourly rate by adding the machine hourly rate and the direct labor hourly rate. In this concept all of the indirect costs are included in the machine hourly rate. However it does not address non machine operation activities such as quality control, material handling, planning etc.

Technology accounting is suggested by Brimson [3]. It suggests that technology cost should be assigned to the product being benefited. This philosophy overburdens the product by idle machine hour when the capacity utilization is less than 100%. Also, this does not take into account the cost of supporting departments that helps in making of products.

1.6 The Need To Separate Idle Time Costs

Idle time is the machine or labor time that could have been used, but not used due to some reason. This idle time once lost can not be recovered for further use. The principle reason for such idle time is incapability of sales department to grab sufficient orders for using production facilities. This idle time does not contribute in any way to the production of product. Thus there is no logic in allocating the idle capacity cost to the product. Unplanned idle capacity cost (other than those that are planned for maintenance, holidays, etc.) **are not the cost incurred in production but a loss** similar to loss on selling capital good and hence should be deducted from the profit earned by producing and selling the products [4], [2], [20].

Decisions like continue or discontinue the product is to be taken on the basis of true cost of production and its selling price. If the product is not a specialized product and there are

number of competitors, then generally the price is determined by the market. In this case one cannot remain in market for long period at a price less than true cost of production. In another case where product is specialized one should know what a product costs to produce in order to set price.

Whether to accept a specialized order as dictated by direct costing is totally a different case than to continue a product. In former case we are with an idle capacity which is used for this special order, where a rupee more than its variable cost (direct cost) will be used to compensate fixed cost and hence reduce loss, whereas in later case a decision is to continue existing product or relinquish and start with new product, a decision, that require correct product costing.

Consider for example a plant running at about 60% of its capacity. Inclusion of unplanned idle costs to the product will boost the true cost of production, which may lead us to relinquish the products as they are not profitable and the case may be categorized as the manufacturing inefficiency of the company to produce the product profitably, but on close watch it will be revealed that the manufacturing efficiency is at par with any other company in the industry, but it is due to other reasons not under control of manufacturing department, that company is not earning profits. One then need to concentrate on that factor that is responsible for such loss.

All of these suggested methods suffer from a common weakness. None of them isolates cost of product from the definition of the overall performance of the business. Also these methods are inefficient for calculating correct product cost in multiproduct situation. Each method has its specific utility, such as direct costing is good for short term decision making and distribution costing is good for measuring the overall performance (profit or loss) of the business. Nevertheless each of these techniques causes the apparent cost of the product to increase when production volume decreases and vice versa.

In this thesis we modify activity based costing methodology to ignore idle time cost while costing a product primarily for the purpose of pricing a product competitively and accumulate costs as production proceeds similar but not identical to ABC. In order to accumulate costs we estimate the cost of activities and sum up the cost as product requires activities. Further we re-do the product cost by Activity Based Costing methodology to see the impact of treating idle times cost as a part of product cost.

Chapter 2

ELEMENTS OF COST

2.1 Labor

Labor is an important element of total production process. It includes all persons employed on machines, person engaged in loading and unloading material, persons engaged in planning, persons engaged in general administrative work of the organization and so on. Labor in manufacturing unit is classified in various ways depending upon one's position in hierarchy or the work and responsibility he/she is looking after.

We classify labor in two categories.

- Direct labor
- Indirect labor

Direct Labor

It is the cost of labor that is directly or expeditiously identifiable with the specific units of products. It may include labor either directly working on machine (e.g., machine operator) or on product (e.g., assembly personnel). Time utilization of direct labor can easily be recorded in daily operator sheet.

The following labors are typical examples of direct labor.

- Machine operator
- Molder
- Assembler
- Packer etc.

Indirect Labor

Indirect labor represents the cost of labor that cannot be related directly to or identified with specific units of production. This would include all labor used in the manufacturing process that has not been handled as direct labor in the cost accounting system. The various classifications of indirect labor are as follows.

Supervision	- the salaries of operating officers, managers and supervisors associated with production.
Material handling	- the wages of personnel involved in moving material within and between departments.
Inspection	- the labor cost of inspection or quality control work performed by inspector.
Repairs & maintenance	- the labor cost of repairing and maintaining machinery, equipment tools, jigs, fixtures, dies.
Technical & clerical	- salaries and wages of personnel involved in supervising, production scheduling, time keeping and engineering.
Other indirect labor	- labor such as sweeper, security personnel, safety inspectors, tool room attendants etc.

The cost of above stated direct labor and indirect labor is required to be allocated to the product. The most common way of paying labor is in the form of monthly salary. Employees also receive fringe benefits such as paid holidays, paid leave, travel allowance, medical reimbursement etc. Employer also frame some mechanism for employees to earn more in the form of bonus. Bonus is paid for ensuring high performance of employees. Thus bonus may be paid for regular attendance or efficiency in production.

Thus labor cost consists of

1. Basic employee wage W
2. Tax & insurance related to wages T
3. Management sponsored fringe benefit F
4. Incentive pay or bonus B

Thus the total cost of individual labor can be defined as

$L = W+T+F+B$

If **Planned Labor Working** hours in a period is PWH then "labor hour rate" can be calculated as L / PWH

Now, we illustrate the calculation of labor hour rate by an example.[20]

Calculation of Labor Hour Rate (Example)

Annual cost of individual labor =	L	(as defined earlier)
Total working days in year		365 days
Less		
Total number of weekly off	52	days
Total number of planned holidays	5	days
Total number of casual leave	12	days
Total number of medical leave	6	days
Total number of earned leave	30	days

Total days deducted	105	days

Total number of actual working days		260 days
Assuming planned one shift working		
Total working hours	260 * 8 =	2080 hours
Labor cost per hour		L / 2080 (Rs/hr.)

2.2 Material

In a broad sense, materials include raw materials, factory supplies such as oil, grease etc. purchased parts and finished parts. These are collectively described as stores since all such items are held in stock in a store room. Material is classified under five different categories.

- Direct materials
- Indirect materials
- Factory supplies
- Finished parts
- Purchased parts

Direct Material

Raw materials used in manufacturing are regarded as direct materials when they form a part of the finished product or can be conveniently charged to a specific product. Examples of direct materials are steel bar, pipe, nozzle, bolts, seals, etc.

Indirect Materials

When materials are consumed in production process but cannot be specifically assigned to particular job or product, they are known as indirect materials. Examples would be foundry sand, welding electrodes, coolants, lubricants etc., electricity, LPG or oil for furnace is also treated as indirect material. In some case the use of indirect material can be directly allocated to the product whereas in other cases it may be directly identified to the particular work station.

Factory Supplies

Indirect materials that are consumed in the course of manufacture but are not physically incorporated in the finished product are known as factory supplies. These include such items as oil, grease, rags, cleaning materials, etc.

Finished Parts

In assembly type production some components are manufactured in advance and stored. These are known as finished parts. They are used in completing the final product in the assembly work and become direct materials while re-entering the assembly area. Finished parts are also sometimes sold as replacement parts.

Purchased Parts

Sometimes finished parts are purchased from outside and used in assembly work e.g. Bearings, v-belts, electric motors etc.

Material discussed are received by store and issued to production on demand. Value of material issued from the store is calculated by any of the popular method such as FIFO, LIFO, Weighted average method and so on. The value of material issued must also include the cost of purchasing efforts, handling efforts and store's cost. The procedure of inclussion of these elements of cost is discussed in detail in Chapter 3.

2.3 Machine or Equipment

Machine or equipment cost is an important constituent of the total cost of the product. General accounting system uses the depreciation value to calculate the cost per unit time use of the machine. However the depreciation figure is dependent on the method of depreciation and the taxable life of the equipment. The "sum of digit" method or written down value method provides for high depreciation in beginning period of equipment life.

A more logical approach for establishing "ownership cost" of machine and equipment can be based on tax life [20]. Tax life of an asset can be used as the basis for computation of depreciation using straight line method. This ownership cost of machine or equipment should continue for the full actual life of asset, regardless of its continuance beyond the tax life. For inclusion of interest rate, when the asset is bought from the retained earnings of the company the interest rate is zero, as no interest is paid on the capital utilized. However if the asset is purchased from the borrowed capital then the actual interest rate shall be used as the interest rate.

If the asset is disposed off early, the salvage income and unabsorbed ownership charges should be treated as an adjustment to enterprise profit, as miscellaneous income or expense. If the machine or equipment is used longer than the tax life, the over-absorbed ownership cost of machine will be treated as a profit or fund to finance the replacement or upgrading of the facilities.

However depreciation is not only the cost associated with the machine but its maintenance cost, the cost of insurance, etc. also contribute to the cost of owning the machine or equipment.

Mathematically, the annual cost of owning the equipment is

$$Ea = D\%(Epc)+I\%(Epc)+Ic+Me+Ue$$

Where,

Ea = annual cost of owning and operating the equipment.

D% = the annual percentage of straight line depreciation for the allowable life of equipment.

Epc = the initial purchase price of the equipment or landed cost of the equipment.

I% = annual interest rate at the time of purchase on the money spent to purchase the equipment.

Ic = the annual insurance cost (fire, etc.) on the equipment.

Me = the annual expected equipment maintenance cost.

Ue = the predicted annual fuel, electricity, water and other utilities to support the equipment.

The same calculation procedure and formula should be used to compute the owning cost rate for each individual item of equipment.

We now illustrate the method of calculation of machine hour rate [20].

Calculation of Machine Hour Rate (Example)

Cost of owning the machine	Ea
Number of days in year	365 days
Less	
Number of weekly off	52 days
Number of holidays	5 days
Planned shut down	14 days
Total annual off	71 days
Planned working days	294 days
Planned working hours per day =	8
Planned working hours in year	294*8 = 2352 hrs.
Machine hour rate	Ea / 2352

2.4 General Administration Cost

General administration includes top executives (not related to production activities), their secretaries, office personnel, accounts department, costing department, cost of sundry supplies, stationery, postage, technical subscription, library, hospitality, professional service, etc [20]. All these costs are recurring in nature and required to be allocated to the product. In many product cost calculation systems, the basic product cost calculation is accomplished by simply dividing all of the costs by the number of units produced. The result is a variable cost estimate that increases the apparent product cost, when production drops and vice versa. The procedure for inclusion of general administration cost in the product is discussed in detail in Chapter 3.

2.5 Building and Space Cost

Any manufacturing company building can be divided into production and non production area. Non production area is one that is not used by manufacturing facilities. Such non production area includes office building, lobbies, garden, toilets, etc. The cost of owning the land and building is required to be allocated to the products. Building includes all civil work, plumbing work and electrical fittings. We have discussed the applicable depreciation rate and interest rate while calculating ownership cost of equipment. The same discussion follows for the depreciation and interest rate for calculating ownership cost of building [20].

Mathematically, the annual cost of owning the building is

$$Ba = D\%(Bpc)+I\%(Bpc)+I\%(Are)+Ic+Mb+Ub$$

Where,

- Ba = annual cost of owning and operating the building.
- D% = the annual percentage of straight line depreciation for the allowable tax life of building.
- Bpc = the initial purchase price of the building.
- Are = the initial purchase price of land.
- I% = annual interest rate at the time of purchase on the money spent to purchase land and building.
- Ic = the annual insurance cost (fire, etc.) on the equipment.
- Mb = the annual expected building maintenance cost.
- Ub = the predicted annual water, lighting and other utilities to support the building.

The process of allocation of cost of owning building and space to the product is dealt with in Chapter 3.

For the allocation of costs to the product we use a three-tier system (Fig. 3.1). All resource costs" are first allocated to the production and non-production departments on the basis" discussed in next section. Once costs are identified with different departments, the standard" number of activities, the department performs is used to calculate cost allocated to perform one activity. The costs of different activities required for the product are then summed up to arrive at product cost.

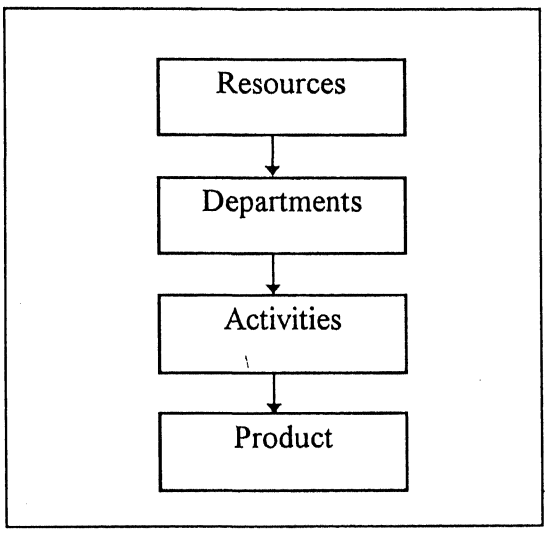

Fig: 3.1 Steps in allocation of costs of resources to the product

3.1 Terms Used In Allocation Of Costs

Time use of facility : It is the amount of time for which the facility is used by the particular product.

Usage rate : It is the time related share of direct cost (direct machine and direct labour) and overheads allocated to the facility.

Net operating space : It is defined as the area utilized by the manufacturing operation and its supporting aisles. It does not include the management offices, toilets, entries, stairs, lobbies and other supporting service area.

Cost driver : It is the reason due to which a department or machine or any facility incurs cost eg. Store incurs cost for holding the material and its receipts and issues. Material handling incurs cost on number of handling.

Chapter 3

A SCHEME FOR ALLOCATION OF COSTS THROUGH MODIFIED ACTIVITY BASED COSTING METHOD

As pointed out in Chapter 1, section 1.6, when the scenario is such that the product mix is changing and the cost of supporting labor and staff personnel is a significant proportion of the total cost and the manufacturing time changes drastically from one product to another then an approach to product costing is required that accumulates the cost of resources required and does not include cost of idle capacity to the product costs. It is essential to separate the operation and product cost from the unused overhead expenses.

In this chapter we develop a "Modified Activity Based Costing" method and illustrate it using cost and other data obtained from Kanpur Industrial Pumps Ltd. In doing this we use various departments in operation and their inter-relationship. The company works with seven major departments, those are stores, personnel, purchase, manufacturing, PPC, Quality Control and General administration that includes accounts department, costing department and Managing Director's office.

We suggest that while the costing system should be based on generally accepted accounting practices, it should be reoriented to reflect the "sum of the cost of activities" required to produce the product. Specifically idle capacity cost should not be added to the product cost and must be shown in profit and loss statement as a loss. It should also allocate costs of production and fair share of overheads to WIP and finished goods inventory on a level-to-level basis, i.e., as the manufacturing proceeds along the production process.

The cost of activity on machine is accumulated through the application of "usage rate" of the machine. This "usage rate" absorbs all overhead related to manufacturing department. The time use of facility by a product accumulates the cost of activity on machine.

3.2 Allocation Of Costs

We have identified the different elements of costs in Chapter 2. In this chapter we discuss the methodology for allocating those costs. We first allocate resource costs to different departments, then to activities and last to products. "Cost drivers" used are explained concurrently. The examples used in this chapter is only to illustrate the proposed method of allocation and do not represent the real data from the company.

3.2.1 Personnel Department Cost

Existence of personnel department is for personnel administration, their time keeping, solving labour problems, maintaining leave records, arranging for periodic training etc. Thus as the number of people increases the work load of personnel department increases. Hence we allocate the cost of total personnel department to different departments on the basis of **number of personnel** in each department. Figure 3.2 schematically represents the allocation of personnel department's cost to different departments. The personnel department's cost is the sum of cost of personnel, cost of computers, allocated cost of stationery and allocated cost of furniture.

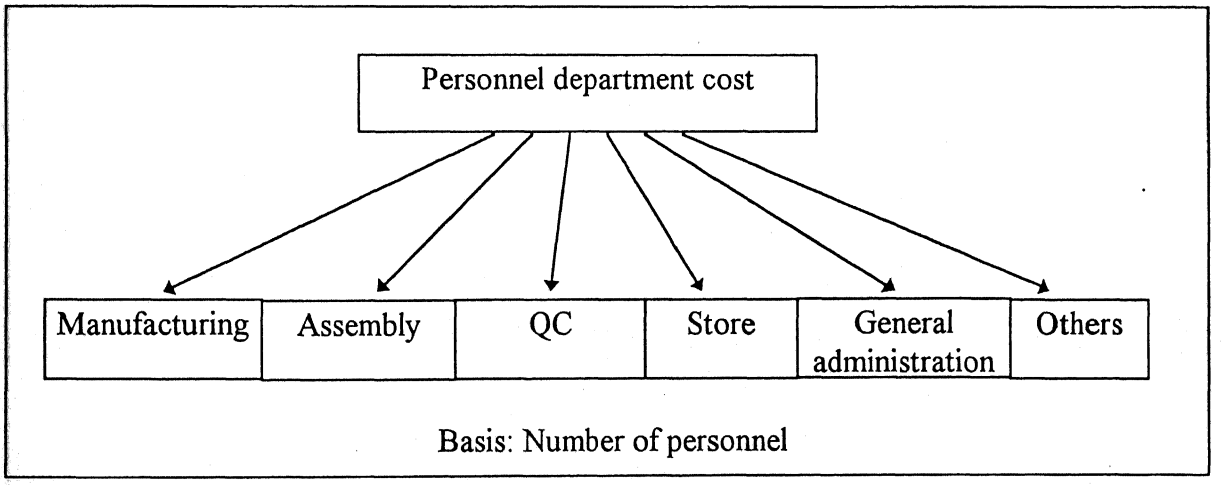

Fig: 3.2 Schematic Representation of Allocation of Personnel Department Cost
Allocation basis is Number of Personnel

3.2.2 General Administration Cost

The responsibility and role of general administration of an enterprise is to manage the use of the capital investment in assets and personnel of the firm in a manner that will achieve the corporate business objectives and benefit the owners and shareholders.

General administration fulfills these responsibilities by the effective administration of the enterprise's assets and personnel. It is therefor logical that general administration expense should be distributed to the product, and the expense must be related to actual capital invested and number of personnel working. An appropriate proportion for this allocation can be decided by management.

The contributors to general administration costs are budgeted cost of directors, their staff, accounts department, costing department, security, postage, telephones, stationery, annual subscription, hospitality. Fig 3.3 represents the allocation of general administration cost to different departments, utilizing an example when a part of general administration is dependent on personnel (GA1), another part is dependent on investment in equipment (GA2), a third part on investment in building (GA3).

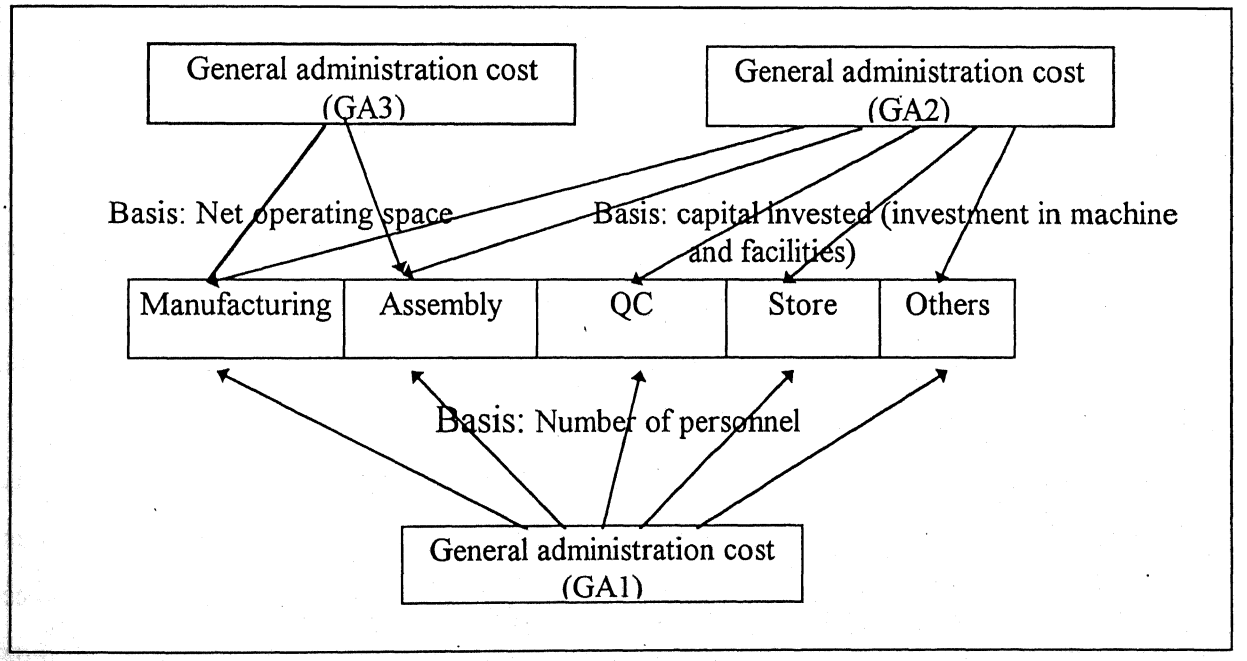

Fig: 3.3 Schematic Representation of Allocation of General Administration Cost Basis of Allocation as Indicated

3.2.3 Store Cost

Store is a facility where all the material whether direct, indirect, factory supplies, finished product, purchased components are received and stored for use on later dates. On the basis of type of material, store is classified as raw material store, finished goods store, WIP store, sundry store (where factory supplies are stored). However this classification depends upon the size of organization, purpose of classification and how organization manages store. We for the purpose of costing, classify store in three

- Direct material store
- Indirect material store
- Miscellaneous store

This classification is necessary for the treatment of their costs. Direct material requires to be allocated directly to the product. Indirect material cost is required to be allocated first to particular machine or manufacturing department. Miscellaneous stores are basically the factory supplies as discussed in Chapter 2, and its consumption is not identified with particular workstation or department. Cost of miscellaneous store, hence allocated to the workstation on the basis of net operating space.

Store is a facility that uses racks, shelves, computers, storemen, stationery, etc. to hold the material and to maintain records of the same. Store cost is thus the summation of the cost of racks, shelves, computers, storemen, stationery, etc.

The use of computer, stationery and storemen is demanded when some receipt or issue is taking place. More receipts and issues mean more computer entry, more material receipt note, more material issue slip, more posting in ledger, more use of storemen. Thus the cost of these items may be well allocated on the basis of "number of receipt and issue".

Racks and shelves are the facilities where the material is kept. Costs of these facilities are to be allocated to the material for the period, it is used by the material. The idea is, material must pay a "rent" for the time it uses the store facility. For this purpose we attempt to calculate cost of using store facilities by Re. 1 of inventory for one day. The facility is used by number of material simultaneously hence we need to know the average inventory value for store utilization. To do this , we have to first estimate store's planned storage as perceived by

the management or the highest figure of inventory on any date in last year or the value of inventory ' today' or the average inventory in last year.

Calculation Of Cost Of One Receipt Or Issue

Expected number of receipt and issue in the coming year or period can be estimated on the basis of total number of receipts and issues last year. Total cost of using computer stationery and storemen is divided by number of receipt and issue to obtain cost of one receipt or issue.

Calculation Of Store's Cost For Re. 1 Of Inventory For One Day In Store

We propose following step by step procedure for estimating holding cost per rupee of inventory per day.

Step 1. Estimate store's "planned storage".

Step 2. Calculate cost of storage for a period i.e. Cost of owning racks, shelves and inventory.

Step 3. Inventory level decided upon in step 1 is expected to be in store on each day. This leads us to calculate "store's cost" of holding re. 1 of inventory for one day.

Store's cost for holding one rupee inventory per day

$$= \frac{\text{cost of storage for the period}}{\text{(Number of days in the period) . (average inventory in the period)}}$$

Step 4. Calculate inventory turnover for each item of store. This gives us the expected time on average the item was in store.

$$\text{Inventory turnover for the item} = \frac{\text{cost of inventory issued in the period}}{\text{average inventory holding for the period}}$$

$$\text{Average time} = \frac{\text{Number of days in period}}{\text{Inventory turnover}}$$

Step 5. At the time of issue of material, charge the material with the cost of using store facility, assume that item was in store for the period computed in step 4.

Assumption made in this process is storage required is proportionate to the purchase price of the item.

Now we illustrate the calculation for "average time the material stays in the store" by an example. Consider a case depicted in Table 3.1, where a particular item is received and issued some number of times. The receipt may be at different rates say (p_1, p_2, ---, p_n) and at different quantity (q1, q2,---, qn). Similarly issues are made for quantities (i_1,i_2 --.i_n) at the rate computed by the predefined rule e.g. LIFO, FIFO, etc. Thus the quantity in store changes as and when receipt or issue of material takes place. Let the dates of receipt or issue be (d_1, d_2,---, d_n).

Date	d_0	d_1	d_2	d_3	d_4	d_5	d_6
Receipt/issue quantity		r_1	r_2	i_1	r_3	i_2	
Unit Price		p_1	p_2		p_3		
Balance Value of Inventory	b_0	b_1	b_2	b_3	b_4	b_5	b_6

Table: 3.1 Example for calculation of inventory turnover and average stay of material in store

Now we calculate the balance value b_1,b_2,--etc. of the material on each of the dates d_1,d_2, -- etc.

Thus,

$$\text{Average stock per day} = \frac{\sum_{t=0}^{n} b_t(d_{t+1} - d_t)}{d_n - d_0} \qquad \text{----(3.1)}$$

$$\text{Total value of issues made} = i_1.\text{Issue value}_1 + i_2.\text{Issue value}_2 \qquad \text{----(3.2)}$$

From equation (3.1) and (3.2) we calculate

$$\text{Inventory turnover for the item} = \frac{\text{Cost of inventory issued in the period}}{\text{Average inventory holding for the period}} \qquad \text{----(3.3)}$$

$$\text{Average time} = \frac{\text{Number of days in period}}{\text{Inventory turnover}} \qquad \text{----(3.4)}$$

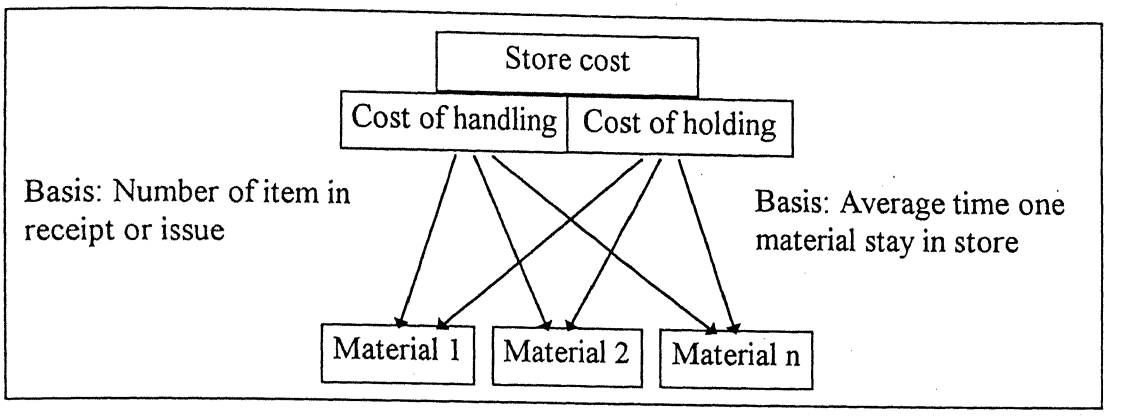

Fig: 3.4 Schematic representation of allocation of store department cost to direct material.

Fig 3.4 represents that the cost of transaction will be added to each material received or issued. Thus when materials against one purchase order are received, each material will be added by equal amount of receiving cost. Fig 3.5 shows that cost of issues of indirect material and factory supplies is divided among different departments on the basis of actual consumption. It is then allocated to the machines on the basis of net operating space of each machine.

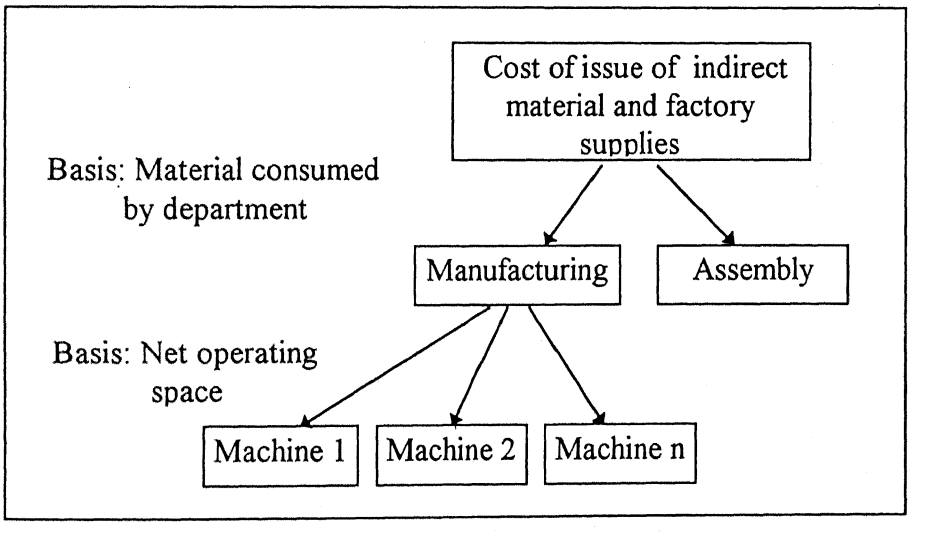

Fig: 3.5 Schematic representation of allocation of store department cost of indirect material to machine.

3.2.4 Purchase Department Cost

The function of purchase department is to locate new and reliable suppliers in the market, raise the purchase order and expedite the purchase procedure. Thus the material received in the store is due to the efforts of the purchase department. As materials to be purchased is increased so is efforts of purchase department. However the efforts are not proportional to the value of purchase but to number of purchases. Thus we propose "number of purchases" to be a relevant cost driver for allocating the cost of purchase department to the material purchased.

The expected number of purchases to be made in a particular period is estimated. The total cost of purchase department is then divided by this expected number of purchases, to get estimated cost of purchasing one material. When material is received, the material purchased is added with the cost of purchasing.

Cost of purchase department is the sum of salary of purchase department's personnel, cost of computers in purchase department, allocated cost of personnel department, allocated cost of stationery and allocated cost of general administration.

3.2.5 Production Planning and Control (PPC) Cost

The function of PPC department varies from organization to organization. Involvement of PPC department starts from the point of inquiry for placing an order in order to estimate delivery date. PPC also does scheduling , sequencing of jobs to all machines. Some questions effectively describe the function of PPC. Which order to expedite? What jobs could be delayed? When should we ask store to supply material? What are the components that are not available for assembly?

Thus we conclude that

- More the components in final assembly more is the necessity of planning and
- More, the number of workstations a component has to move, more planning and scheduling efforts are required..

Above discussion provide strong reason to allocate PPC cost on the basis of number of stations a particular component visits. Thus if one component is visiting ten machines and

other only two machines then allocation of PPC cost to first component must be five times than to the second component. This gives us a motive to improve product design such that job can be completed on minimum number of machines so as to fetch minimum PPC cost. The cost of PPC department includes cost of PPC personnel, cost of computers, allocated cost of personnel department, allocated cost of stationery and allocated cost of general administration.

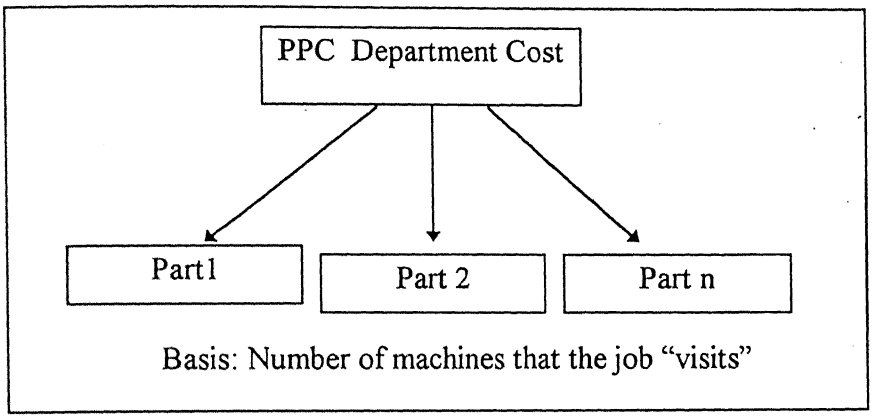

Fig: 3.6 Schematic representation of allocation of PPC department cost.

3.2.6 Material handling Cost

We classify material handling equipment in two different categories.

- Restricted equipment
- Unrestricted equipment

Restricted equipment/ machines are those that are fixed in particular area. For example Electric overhead travel (EOT). Thus if EOT is fixed in the assembly area then cost of owning EOT should be assigned to assembly section and not to other facilities, where it is not in use. and the cost be allocated to the product depending upon the time it stays in assembly section.

However there may be some light material handling machine such as hydraulic jack, trolleys, pallets etc. Which cannot be identified to particular product or work station then the cost of all such equipment or machines shall be added to the product on the basis of number of handling. The cost of material handling department includes cost of material handling personnel, cost of material handling equipment and allocated cost of general administration

Calculation For Cost Of One Handling

When a company is working at different level of capacity utilization, it is rather difficult to value one handling for such circumstances we propose following methodology to estimate cost of one handling.

Step 1 : Identify the departments where there is restricted material handling equipment.

Step 2 : Estimate number of handling in such department.

Step 3 : Calculate share of restricted equipment for one handling.

Step 4 : Estimate number of handling in all departments.

Step 5 : Calculate share of unrestricted equipment for one handling.

Step 6 : Cost of handling where there is no restricted equipment is as calculated in step 5.

Step 7 : Cost of handling where there is restricted equipment is summation of cost calculated in step 3 and step 5.

Sample study the days for completion of batches on different machines. Judge the utilization using our perception of full utilization. On the basis of available data project number of handling for full utilization.

3.2.7 Quality Control Department

Quality control department checks the confirmation of the product to the drawing standards. On the basis of confirmation the components are accepted or rejected. Once a batch is completed on a machine it is checked by QC personnel. Inspection of final assembly generally takes more time than inspecting a batch on machine. Inspection time on machine is about 15 min. On the other hand inspection of assembly takes about 4 hrs. Above discussion provides strong basis to allocate QC cost to the product on the basis of amount of time consumed by QC department for inspection of parts. The cost of quality control department is the sum of cost of quality control personnel, cost of quality control equipment, allocated cost of general administration, allocated cost of personnel department and allocated cost of stationery

3.2.8 Indirect Manufacturing Labor Cost

These are the labor in manufacturing department but are not directly connected to the operations on machines for example supervisor, manager etc. It is proposed to allocate such budgeted cost on the basis of net operating space. Fig 3.7 represents the allocation of indirect manufacturing labor on the basis of net operating space of the individual machine.

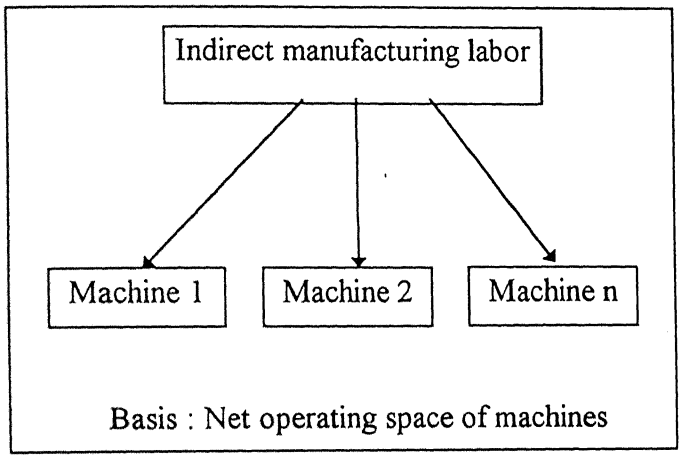

Fig: 3.7 Schematic Representation of Allocation of Indirect Manufacturing Labor Cost.

3.2.9 Annual Building and Space Cost

Annual cost of owning the building and space is calculated as discussed in Chapter 2 Section 2.5. As the effective area of working is the operating space of each workstation, the annual cost of building and space is then allocated to each workstation depending upon its operating space. Fig 3.8 represents the allocation of anual building and space cost on the basis of net operating space of the individual machine.

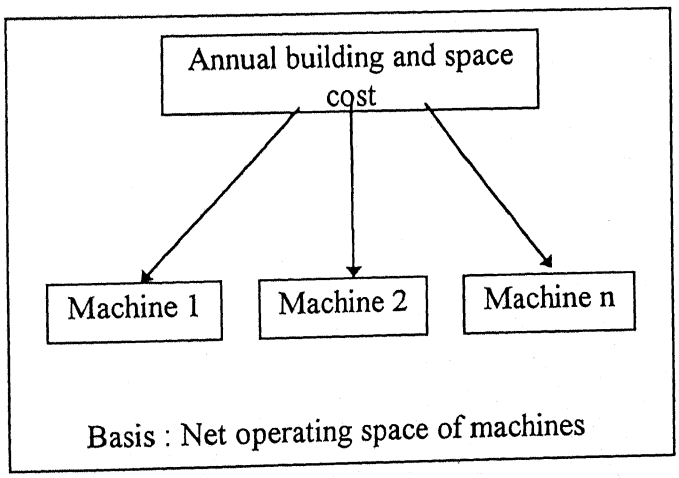

Fig: 3.8 Schematic Representation of Allocation of Annual Building and Space Cost.

Chapter 4

STUDY OF EXISTING INFORMATION AND COSTING SYSTEM IN KANPUR INDUSTRIAL PUMPS LTD. - A CASE STUDY

Kanpur Industrial Pumps Ltd*. (KIPL) is engaged in the manufacturing of wide range of industrial pumps. Each pump requires different raw material and purchased components and takes different amount of time on production facility. Thus it is a multi-product company that demands different resources in varied amount and is appropriate to our study of costing and information system. In this chapter we study the existing information flow system and costing system in KIPL.

We begin with brief introduction to the company and then discuss the procedure and information flow in the different departments. At the end we critically analyze the existing information and costing system for better managerial decision support.

4.1 Introduction to Kanpur Industrial Pumps

Kanpur Industrial Pumps was established in 1973. The company has registered office in New Delhi and production plants at Kanpur and Vadodara. It engages in the design and production of industrial pumps. In the past 25 years the company has gained expertise in the manufacturing the industrial pumps in the range from 1 HP to 50 HP.

The company produces three broad pump types.

1. Single screw pump
2. Double screw pump
3. Centrifugal pump

* The name of the company has been disguised to preserve anonymity.

Each of the above classified pump is further classified to about 25 different products depending upon size, capacity, RPM etc. The company supplies its pump to different customers. The customers of KIPL range from small entrepreneurs to Indian Oil Corporation.

4.2 Organization Chart of Kanpur Plant

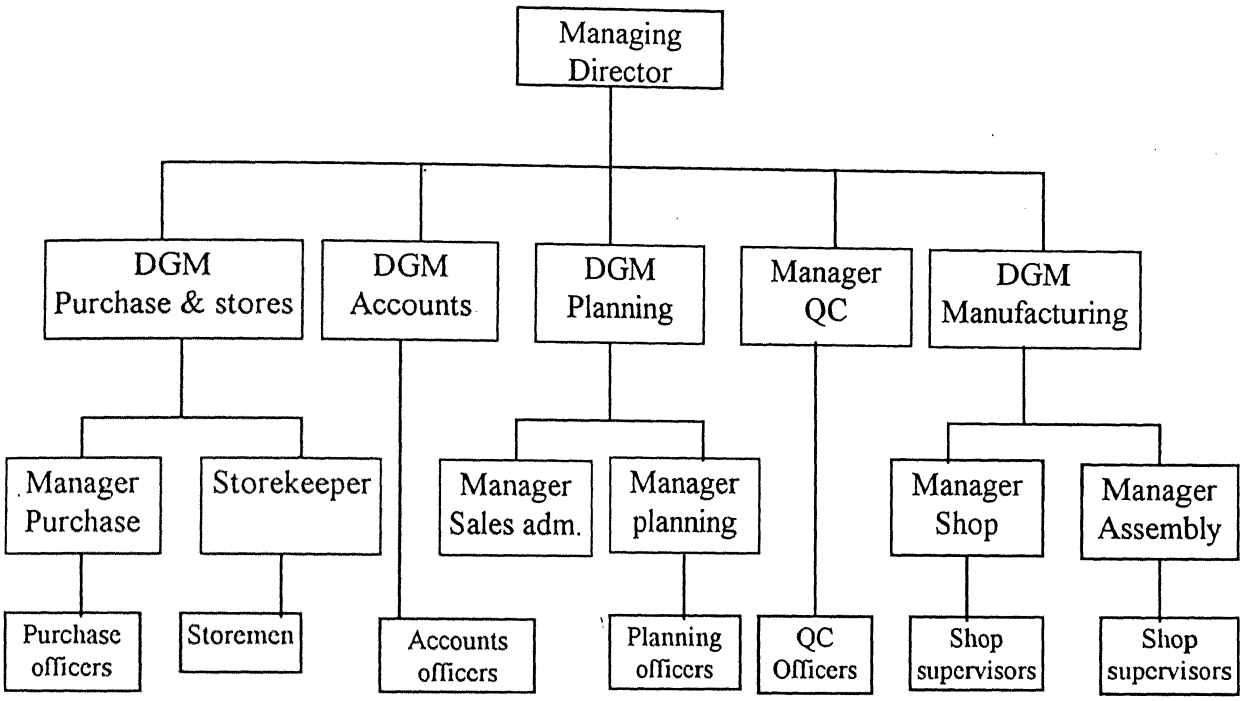

Fig. 4.1 Organization chart of KIPL

The Fig. 4.1 shows the organization chart of KIPL Managing Director heads all the departments. The responsibility of individual department is given to Deputy General Manager (DGM) level position. DGM (purchase and stores) supervises the activities of purchase and store and is responsible for searching reliable vendor, placing order, expediting the purchase and availability of material in store. Manager purchase and Storekeeper report to DGM (purchase and stores). Manager purchase has purchase officers to assist his work. Purchase of raw material and finished parts and miscellaneous items are done by different purchase officer. Manager Planning works under DGM Planning and is responsible for day-to-day planning activities. DGM Planning act as a link between plant and customer through Manager sales administration. He is the person who decides upon what jobs to expedite or to delay, what due date should be given to customer and so on. DGM Manufacturing is responsible for completion of work. He is assisted by shop managers (machine shop manager, foundry

manager, assembly manager). These shop managers work in shifts and have shop supervisors to assist their work.

The company employs about 80 workers on shop floor and 30 staff personnel. The plant runs for 2 shifts per day. Stores and QC are the supporting departments that work in 2 shifts; planning, purchase, sales administration work in 1 shift only.

4.3 Plant Layout

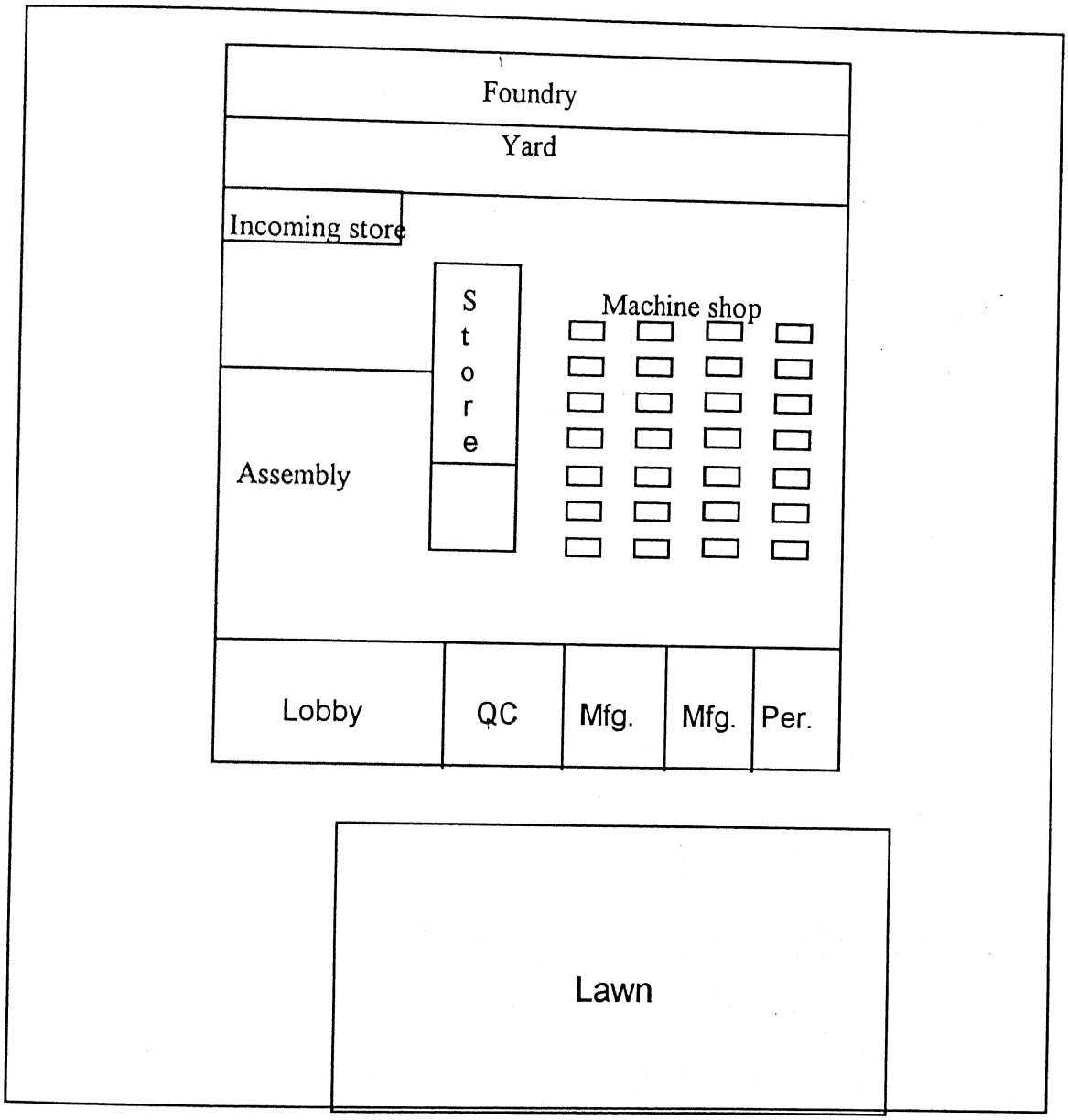

Fig. 4.2 Plant layout of KIPL

4.4 Objectives of Management for System Development

Company has experienced a steep rise in its stock holding, (refer Table 4.1). The preliminary study done at KIPL reveals some facts that provides rationale to design a system that caters to the information need of management. This pilot study shows that the 2% (by value) of the raw material stock is the dead stock and about 14% (by value) stock is the slow moving stock. In the case of bought out finished parts & components stock, (refer Table 4.2), in "Bearings" 14% of the items contribute 75% of value, in "Mechanical seals" 4% of items contribute 76% of value, and in "Rubber components" 8% of the items contribute 74% of total value. These high valued items were lying in the store for about six months, without a single issue after receipt. Management was ignorant about the fact. In the case of manufacturing some components were lying in the shop for abnormal period.

	Apr	May	Jun	Jul	Aug	Sep	Oct
Raw material	42	45	45	48	46	56	52
Bought Parts	25	25	27	27	28	25	28
Finished Parts	71	78	89	85	84	92	95
Electrical Part	17	36	43	44	46	32	45
Finished goods	30	25	17	10	11	9	12
WIP	51	54	58	77	78	68	70
Total	**236**	**263**	**279**	**291**	**293**	**282**	**302**

Table 4.1 Summary of monthly stock holding report (Figures in lakh)

Proportion	Bearing	Mech. Seal	Rubber Comp.
% by number	14%	4%	8%
% by value	75%	76%	74%

Table 4.2 Proportion of bought out components by number and value

Management was concerned to reduce such blockage of money, that was due to ill management of store and shop floor. In addition management is not confident about the stock figures reported by the accounts department in the monthly stock report. The company's present costing procedure calculates the cost of stock holding and the product cost (by adding a percentage on raw material). Percentage is determined on the basis of past experience of managers and does not account the actual working in plant.

The plant has installed a Management Information System (MIS) in 1994. Presently the use of MIS is restricted to accounts department. With the increasing competition in the business the company is more concerned to reduce blockage of funds, reduction in idleness of capacity and evaluation of different products for their profitability. The need of being competitive raises the need of proper planning in store, that require up to date information of store to take decisions; the precise costing technique that cost parts as they are manufactured and information on performance of different departments.

4.5 Overview of Major Subsystems

From an overview standpoint the KIPL can be described as a material flow company. This concept is illustrated in (Fig. 4.3) as a thick line arrow. Purchased material and manufactured materials flow into various stages of the production process. The raw material takes on a variety of forms and shapes until they become finished stock. The finished stock is then assembled to order and dispatched to the customer.

Coupled with material flow is their corresponding information flow (Fig. 4.3). To illustrate the concept of information flow, the sales administration get the order from customer and hand over to PPC for planning and manufacturing. Goods in short in store is ordered by the purchase department on indent, produced by PPC. Material received against purchase order is received and handled by incoming stores. Manufacturing department on direction from PPC get the material from incoming stores, produce the components and hand it over to finished goods stores. Finished goods store release the material to assembly on the direction of PPC. Assembly after completion of pump report to PPC who releases the dispatch order.

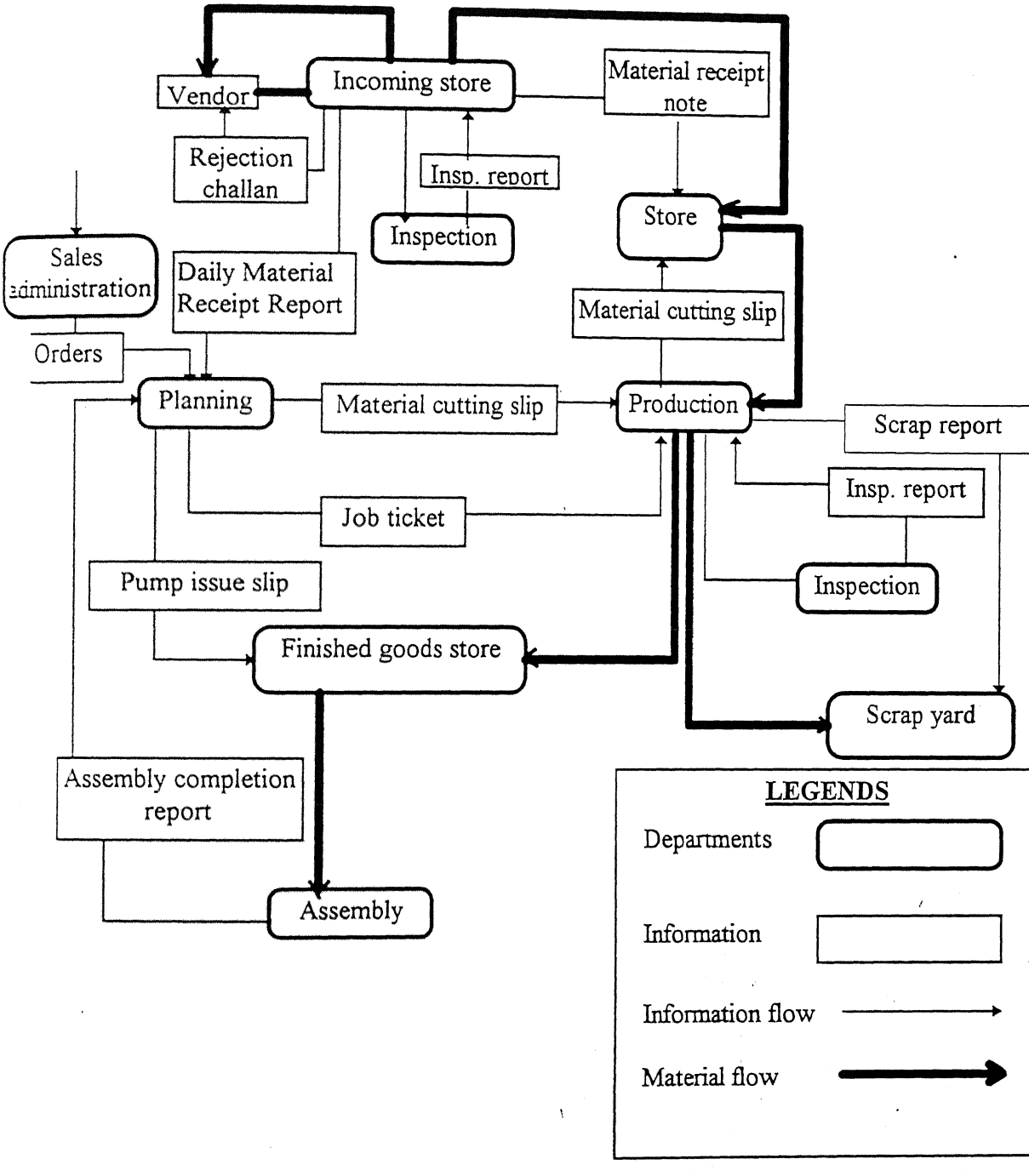

Fig. 4.3 Information flow in KIPL

4.5.1Store Subsystem

Store in KIPL handles four different categories of material.

1. Bought out raw material.
2. Bought out finished parts.
3. Semi-finished or finished components from vendors.
4. Own manufactured finished stock.

Bought out raw material, bought out finished parts and semi-finished or finished components are received from vendors by incoming store. Incoming store makes material receipt note (MRN) (sample MRN Fig. 4.4) in quadruplicate and informs QC for inspection of the received material. The bought out finished parts and finished components from vendors are sent to finished store with one copy of MRN. Finished stores make the necessary ledger entry and update the balance. In the case of bought out raw material and semi-finished component ledger is updated by incoming store. A rejection challan is made for rejected material and is sent back to the vendor. Incoming store also prepares daily material receipt report (DMRR) and send a copy of the same to PPC, purchase and manufacturing subsystem for the information that particular material has arrived.

MATERIAL RECEIPT NOTE

Supplier's name

MRN No. _____ Date:_____
Security No._____ Date:_____
Challan No. _____Date:_____

Purchase Order No._____

S.No.	Code	Item Description	Rate	Received	A/c unit	Passed	Rejected

Fig.: 4.4 Material Receipt Note (Sample)

Pump Issue Slip (PIS) floated by PPC to store is an authority to store to issue the material to the pump assembly section. When PIS is received by store the finished components are issued to the assembly section. If some material falls short in store a supplementary issue slip given by PPC is an authority to issue the material. The PIS and supplementary issue slip are preserved for later reference. Entry in ledger is done manually. Monthly stock report is prepared by storekeeper as a report to management.

4.5.2 Production Planning and Control (PPC) Subsystem

PPC is the apex subsystem working with almost all subsystems. It gets the orders from sales administration. Orders can be classified in two different categories:

- Order for new pump
- Order for spares

PPC makes one month production plan and releases job orders to manufacturing subsystem. Each part to be manufactured is given different job order number. It works on some thumb-rule for their dispatch schedule. Delivery period depends on the type of pump ordered. Following is the typical delivery period presently in practice.

- Single screw pump 1 month
- Double screw pump 3 months
- Centrifugal pump 3 months

PC also look for raw material available in yard and release "purchase indent" to purchase department. It issues Pump Issue Slip (PIS) or Spare Issue Slip to finish goods store for issue of finished components to pump assembly or for packing for spares dispatch

When the assembly of the pump is complete a Pump Completion Report (PCR) is sent from assembly to PPC. This report certifies that pump is complete and working as intended. One copy of this Pump Completion Report is sent to Sales Administration for dispatch.

4.5.3 Purchase Subsystem

The basic function of purchasing can be expressed as procuring/buying materials of the right quality, in right quantity, at the right time and at the right price.

The purchasing procedure in KIPL is initiated by different departments. These departments are

- Stores Indent miscellaneous stock items
- PPC Indent against orders

Purchase order is made in quadruplicate, original is sent to vendor, one copy is retained with the department, and other two are sent to store and accounts department.

4.5.4 Manufacturing Subsystem

The responsibility of manufacturing subsystem is to manufacture parts on order from PPC. Loading of machine and material movement from machine to machine is the major responsibility of manufacturing department. Manufacturing department keep track of the movement of individual part by maintaining a log book. The sample page of log book is shown in Fig. 4.5.

Date	Job order No.	Part No.	received from store	Intermediate insp.	Final insp.	Received by finish goods store	
2/3/97	9710110		10/3/97	15/4/97	4/5/97	6/5/97	

Fig. 4.5 Log book page (Sample)

he order by PPC is in the form of "Job Order". Job order contain the job order number, part description, drawing number, material description, and quantity required. The sample "job order" is given in Fig. 4.6

JOB CARD

Issue slip no		970626 12/11/97		Job card No.		01-781451 12/11/97	
Product	Name	Shaft		Type RVN40		OA	
	Qty.	1	Drg. No.	Drg. attached		Code S32907DOPS1	
Raw mat.	MOC	Size	L B	Qty/Pc.	Qty.	Code	
Round	SS 316	Dia 20mm	"741"	2	2	W04020D00B0	
S No.	Work centre		Operation	Tool no.	Pass	Rej	Shop sup

Fig. 4.6 Job Card (Sample)

4.5.5 Assembly Subsystem

When PPC get the information that required parts for required pump is available in finish goods store, it issues the Pump Issue Slip to assembly department. This PIS is an authority for assembly department to get material issued from finished goods store for assembly. Assembly department after completion of pump assembly and its inspection by QC personnel, furnishes a Pump Completion Report to PPC department.

4.6 Existing Product Costing and Stock Valuation Method

At present the products are valued on the basis of direct material cost with "percentage of direct material" added as the share of overhead. The direct material is valued on the basis of last year's price. Thus the value of material issued remain constant through out the year, irrespective of current changes in price.

At the end of every month, for monthly stock calculation the manufacturing personnel enter the state of work completed by judgment and submit it to accounts for further calculation.

Accounts department has a ready-made table (Table 4.3) for the calculation of manufacturing cost. Thus if the raw material for a particular component of single screw pump is stainless steel, that cost Rs. 200, then, when the job is completely finished its value will be 200+ 20% of 200 = Rs. 240.

	Single screw	Double screw	Centrifugal
Cast Iron	50%	100%	30%
Cast Steel	50%	100%	30%
Stainless Steel	20%	30%	10%
EN **	50%	100%	50%
Mild Steel	50%	100%	20%
Gun Metal	10%	10%	10%

Table: 4.3 Table showing percentage of direct material cost to be added to material cost as an overhead for different types of pumps.

For the valuation of WIP, the current completion status is recorded by the manufacturing supervisor and handed over to accounts department. Depending upon the state of completion the appropriate proportion of cost is allocated to the part. Thus if the job is 50% completed in our example, then the value of WIP will be 200+ 50% of (20% of 200) =Rs. 220.

4.7 Critical Analysis of Existing Product Costing and Stock Valuation Method

The method of costing in use, in KIPL, was developed at the time, when the scale of operations was small and the facility for computation of cost at high speed was not available. The need for precise product costing was also not recognized, when there was less

competitive environment and with the availability of computers the method of costing discussed in section 4.6 is not sufficient for the purpose of cost control. We need a system that will calculate cost of all the activities as and when it occurs to have costing on-line. This system must also be capable of providing data for day-to-day planning purpose. The present system does not point to the reason(s) for increase in inventory over the period as shown in table 4.1. This system is also incapable of controlling high valued stock as shown in Table 4.2.

The overhead assigned to particular part is neither dependent upon the cost of the material nor on the type of material. The allocation of overhead should be made proportional to the demand a particular part puts on use of overheads. The present method also does not reflect the efficiency or inefficiency of manufacturing department in the valuation of stock. The status of completion of the parts is filled by the manufacturing supervisor. Judging the completion of the parts can not be made with precision and may give unsatisfactory stock valuation. The objectives of management for better planning and use of available resource and cost control can not be achieved by the present system. In order to fulfill the management's need of precise product costing and stock valuation and better planning we develop the costing system that can report data on-line to facilitate management to take better decisions.

The existing method of "percentage mark-up on material cost" does not facilitate variance analysis as no method is in practice to collect the machine time and direct labor time required. The proposed method of costing systematically accumulates the machine time and labor time required for a particular product. These facilitate us to compare the actual time required with the standard time required and do the variance analysis.

Chapter 5

SAMPLE COST CALCULATION OF PUMP COMPONENTS BY MODIFIED ACTIVITY BASED COSTING SYSTEM

In this chapter we use the proposed costing system to calculate cost of three different pump components in KIPL. These three components are such that, they need different raw material and are processed on different machines for different amount of time. At last we compare the cost of components arrived at through suggested method and presently followed costing procedure.

5.1 Personnel Strength in Departments

Information about number of personnel in each department and their annual salary is shown in Table 5.1. There annual salary includes monthly wages, yearly bonus and PF contribution. The salary figures presented are rounded to nearest thousand and are related to the period April 96 to Mar 97.

Departments	No. of personnel	Annual Salary
Personnel	4	356,000
General administration	18	2,022,000
Purchase	5	423,000
Stores	6	395,000
PPC	4	376,000
QC	3	252,000
Manufacturing	70	3,648,000
Assembly	12	732,000

Table 5.1 Department-wise number of personnel and salary

5.2 Capital Investment in Departments

Table 5.2 presents the amount of invested capital in each of the departments. Investments in Purchase, PPC and general administration are the investment in furniture and fittings

whereas investment in manufacturing and assembly and material handling represent the investment in machines and equipment. We use straight line depreciation method at the rate of 10% to calculate the depreciation per year.

Departments	Capital investment	Depreciation
Personnel	5,000.00	500
General administration	45,000.00	4500
Purchase	10,000.00	1000
Stores	50,000.00	5000
PPC	10,000.00	1000
QC	100,000.00	10000
Manufacturing	9,700,000.00	970000
Assembly	200,000.00	20000
Material handling		
Restricted to assembly	80,000.00	8000
Unrestricted	20,000.00	2000

Table 5.2 Department-wise investment

5.3 Estimate of Planned Store Capacity

The average store capacity is obtained from the data in Table 4.1. Discussion with store and planning managers pointed that the present level of store holding is higher than expected and they want to lower down the holding to Rs. 1 Crore. Thus we estimate planned inventory in stock to be Rs. 1 Crore. Stock higher than planned will reflect poor performance and lower than planned will indicate better performance of store department.

5.4 Estimate of Standard Number of Material Purchased

We have counted the number of materials purchased in last eight months, i.e. from April 97 to Nov. 97. The number of materials purchased for each month is shown in Table 5.3.

	April	May	June	July	Aug.	Sep.	Oct.	Nov.
Count of material order	87	63	56	50	62	105	73	69

Table 5.3 Month-wise count of materials purchased

The total of materials purchased from April through Nov. 97 is 565. From this we estimate standard number of material purchased to be 70 per month. for calculation of cost of purchasing one material, we divide cost of operating purchase department for one month by 70.

5.5 Estimate of Standard Number of Receipts and Issues

The numbers of receipts are obtained through the count of material receipt note and finished goods' receipt vouchers in a particular month. The issues are obtained by counting material cutting slips, pump issue slips and supplementary pump issue slips. The table 5.4 present the number of receipts and issues found in four months.

	Receipt	Issue	Total
July	183	345	528
Aug	174	412	586
Sep	138	302	440
Oct.	165	287	452

Table 5.4 Total number of receipts & issues

The total receipts and issues in four months are 2006. Thus standard receipt and issues per month are estimated to be 500. Cost of one receipt or issue is calculated by dividing cost of operating store for one month by 500.

5.6 Net Operating Space

It is defined as the area utilized by the manufacturing operation and its supporting aisles. It does not include the management offices, toilets, entries, stairs, lobbies and other supporting service area. The size of area utilized by the manufacturing department is 80 ft. by 65 ft. i.e. 5200 sq. ft., and area utilized by assembly department is 60 ft. by 30 ft. i.e. 1800 sq. ft. Thus total of net operating space of the company is 7000 sq. ft. The manufacturing department has 26 machines arranged in 4 rows, with 7 machines in each of the 3 rows and 5 machine in one row.

5.7 Sample Cost Calculation

We now present cost calculation of three different components by "percentage mark-up on material cost", "activity based costing" and proposed "modified activity based costing" methods. For arriving at the cost of the department we have first allocated the cost of personnel department and then the general administration cost to all other departments as discussed in Chapter 3. The allocation of personnel department cost and general administration cost to other departments is shown in Table 5.5 and Table 5.6. The company has invested

Rs. 55 Lakh in building and Rs. 102 Lakh in machines & equipment. The general administration cost is allocated to each department on the basis of personnel and invested capital in the department. 50% of the general administration cost is allocated on the basis of personnel and other 50% on the basis of invested capital. Table 5.7 shows the allocation of general administration cost to the material handling equipment on the basis of investment. The total cost is then allocated to the product on the basis of number of handling required by the product.

Departments	Personnel	Investment	Depreciation	Salary	Stationery	Cost of personnel dept.	Allocated cost of pers.dept.	Cost of dept.
Personnel	4.0	5,000.0	500	356,00	1,00	357,500.0		
General administration(GA)	18.0	45,000.0	4,500	2,022,00	6,00		54,533.9	2,087,033.9
Purchase	5.0	10,000.0	1,000	423,00	5,00		15,148.3	444,148.3
Stores	6.0	50,000.0	5,000	395,00	2,00		18,177.9	420,177.9
PPC	7.0	10,000.0	1,000	376,00	1,50		21,207.6	399,707.6
QC	3.0	100,000.0	10,000	252,00	1,00		9,088.9	272,088.9
Manufacturing	67.0	9,700,000.0	970,000	3,648,00	1,20		202,987.2	4,822,187.2
Assembly	12.0	200,000.0	20,000	732,00	1,00		36,355.9	789,355.9

Table 5.5 Total cost of department after allocation of personnel department cost on the basis of number of personnel

Departments	Cost of department. From table 5.5	Alloc. of GA cost on personnel basis.	Alloc. of GA cost on investment basis.	Dept. Cost
General administration	2,087,033.90			
Purchase	444,148.31	52,175.85	663.81	496,987.97
Stores	420,177.97	62,611.02	3,319.07	
PPC	399,707.63	73,046.19	663.81	473,417.63
QC	272,088.98	31,305.51	6,638.15	310,032.64
Manufacturing	4,822,187.29	699,156.36	643,900.41	
Assembly	789,355.93	125,222.03	13,276.30	927,854.26

Table 5.6 Total cost of department after allocation of general administration cost

Material handling	Cost of m/c	Depreciation	Alloc. Cost of GA	Total cost
Restricted to assembly	80,000.00	8,000.00	5,310.52	13,310.52
Unrestricted	20,000.00	2,000.00	1,327.63	3,327.63

Table 5.7 Cost of material handling equipment after allocation of general administration cost

From Table 5.5 and Table 5.6 we calculate the cost of store department required for holding the stock and handling (i.e. receipt and issue) the stock. Table 5.8 shows the summation of costs for calculating store's holding and handling cost.

	Depreciation	GA share on investment	Salaries of store department	Stationery in Store	Alloc. Cost of personnel dept.	Alloc. Cost of GA on personnel	Total
Store's cost of holding	5000	3319.07					8319.07
Store's cost of handling			395000	2000	18177.97	62611.02	477788.98

Table. 5.8 Cost of holding and Cost of handling in Store

The manufacturing department has eleven indirect labors, these labors include managers, supervisor and helpers. The sum of salaries paid to indirect labor is Rs. 962,000.00. Total indirect costs of manufacturing include cost of stationery, allocated personnel department cost, allocated general administration cost on the basis of personnel and indirect manufacturing labor salaries. Thus from Table 5.5 and Table 5.6 we calculate total indirect cost in Table 5.9.

	Indirect labor salary	Stationery in mfg.	Alloc. Cost of personnel dept.	Alloc. Cost of GA on personnel	Total
Total indirect cost	962,000.00	1200	202987.29	699156.36	**1865343.64**

Table 5.9 Calculation of Total indirect cost

Calculation of Direct Labor Hour Rate

From Table 5.5

Total salary paid to manufacturing labor = Rs. 3648000.00

Less

Salary paid to indirect labor = Rs. 962000.00

Total direct labor salary = Rs. 2686000.00

Total number of direct labor = 56

Standard. annual working hours per labor = 2,080

Total annual labor hours = 116,480

Cost per direct labor hr. = Rs. 23.06

Total capital invested in building is Rs. 55 Lakh. Table 5.10 shows the allocated general administration cost to the building, annual insurance and annual maintenance cost of the building. The depreciation for the building is calculated on straight line basis for 25 years.

Total cost of owning the building per year is thus Rs. 602598.17. This cost is then allocated to individual workstation on the basis of net operating space of that workstation.

Depreciation annual	alloc. of GA cost on investment basis.	Insurance annual	Maintenance annual	TOTAL annual
220,000.00	365,098.17	5,500.00	12,000.00	**602,598.17**

Table 5.10 Annual cost of owning the building

Net operating space in manufacturing and assembly section is 5200 and 1800 sq. ft. The indirect cost of manufacturing is then allocated on the basis of net operating space. Thus the share of indirect cost per sq. ft. Is Rs. 358.72. the cost of owning the building is also allocated on the basis of net operating space of the factory. Table 5.11 shows the allocated cost per square feet in manufacturing and assembly section.

	Net operating space	Indirect mfg. cost	Indirect labor per sq. ft.	Alloc. Building cost per sq. ft.	Total alloc. Cost per sq. ft.
Manufacturing	5,200.00	1,865,343.64	358.72	86.09	444.81
Assembly	1,800.00			86.09	86.09
Total	7000.00				

Table 5.11 Allocated cost per square feet in manufacturing and assembly department

Calculation of Machine Hour Rate

As stated earlier manufacturing department has 26 machines. Table 5.12 presents data on expenses pertaining to a few machines. These are the machines that are required for manufacturing of components of which we have calculated the cost in next section. In Table 5.13 we allocate indirect cost and cost of building to the individual machine on the basis of net operating space of that machine. General administration share is allocated to each machine on the basis of invested capital. Total cost is then divided by 4912 hours (annual planned operating hours) to arrive at the cost of machine hour rate.

Manufacturing	Operating space	Purchase price	Annual maintenance	Utilities Power etc.)	Depreciation annual	Total
Lathe m/c	200.00	550,000.00	10,000.00	35,000.00	55,000.00	100,000.00
Vertical milling m/c	150.00	275,000.00	4,000.00	30,000.00	27,500.00	61,500.00
Grinding m/c	175.00	600,000.00	5,000.00	40,000.00	60,000.00	105,000.00
Radial drilling m/c	275.00	300,000.00	2,000.00	10,000.00	30,000.00	42,000.00
Vertical boring m/c	150.00	250,000.00	1,000.00	15,000.00	25,000.00	41,000.00

Table 5.12 Annual expenses for machines

Manufacturing	Total from Table 5.12	Alloc. cost of indirect lab & bldg.	GA share on invest.	Total	M/C hour rate
Lathe m/c	100,000.00	88,961.08	36,509.82	225,470.89	**45.90**
Vertical milling m/c	61,500.00	66,720.81	18,254.91	146,475.72	**29.82**
Grinding m/c	105,000.00	77,840.94	39,828.89	222,669.83	**45.33**
Radial drilling m/c	42,000.00	122,321.48	19,914.45	184,235.93	**37.51**
Vertical boring m/c	41,000.00	66,720.81	16,595.37	124,316.18	**25.31**

Table 5.13 Calculation of machine hour rate

Calculation of Different Activity's Cost

The manufacturing support department is expected to work at the same level as it has worked in past six months. The expected number of receipts and issues in the year is calculate on the basis of data presented in Table 5.4. Expected monthly receipts and issues are 500. From this we estimated expected receipts and issues in one year to be 6000. At 60% utilization of plant the number of receipts and issues are expected to be 4000.

The annual holding cost of stock in store is Rs. 8319.07. This is divided by planned stock holding to calculate cost of holding Re. 1 inventory per day. The amount so obtained is then added to the interest cost of holding Re. 1 inventory per day. The interest rate used for this purpose is 18% (ref. Table 5.14).

Cost of purchasing material is calculated by dividing purchase department cost by expected number of purchase to be made in one year. Expected number of purchases to be made is obtained from the data presented in Table 5.3. Average number of purchases made in past six months is 70 per month. From this we estimate average number of purchases for the year to be 840 (ref. Table 5.14). At 60% utilization of manufacturing facilities it is expected that, there would be concurrent reduction in material purchases and we take it to be 475 for illustration purpose.

In order to calculate the inspection cost per hour, 80% of total time is expected to be the planned utilization. At reduced utilization we assume inspection department to be utilized for only 55%. The calculation steps are shown in Table 5.14.

Average number of material handling per day is 50. The total cost of PPC and material handling is allocated to expected number of handling in a year. The expected number of handling in a year is obtained by multiplying 50 with number of working days in a year i.e.307. At reduced utilization we assume material movements to reduce by same amount and expect it to be 9200.

		At planned utilization	At 60% utilization*
The cost of stores		477,788.98	
Expected receipt & issue in one year		6,000.00	4,000.00
Cost of one receipt & issue		**79.63**	**119.45**
Annual holding cost of stock		8,319.07	
Planned stock holding per day		10000000.00	10,000,000.00
The cost of holding Re 1 inventory for 1 day		**0.0004954**	**0.0004954**
Cost of purchase dept.		496,987.97	
Expected number of material purchased (12 * 70)		840.00	475.00
Cost of purchasing one material		**591.65**	**1,046.29**
Cost of inspection dept.		310,032.64	
Assuming 80% utilization as standard, std hours		5,644.80	3,880.00
Standard hours	2,352.00		
No of persons	3.00		
Total hours	7,056.00		
80% of total hrs.	5,644.80		
Cost of inspection hour		**54.92**	**79.91**
Expected material movement per day	50		
We estimate total movements in a year			
No of working days	307.00		
Total movements		15,350.00	9,200.00
Cost of PPC dept.	473,417.63		
Cost of material handling	3,327.63		
Cost allocated to material movement	476,745.26		
Cost of one handling		**31.06**	**51.82**

Table 5.14 Cost of doing one activity

* Actual figures are likely to be somewhere between this column and previous column figure.

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5.7.1 Cost Calculation for "Top Line Shaft"

Top line shaft is made from stainless steel material named by SS 316. The required raw material for this component is ϕ 20 X 741 mm. The raw material is required to be processed on three different workstations. The operation sequence is shown in Table 5.15. Time required by the component for operation sequence number 1 through 3 on Lathe machine is 45 minutes and for operation sequence number 5 through 7 on Radial drilling machine is 20 minutes.

Sequence	Operation	Workstation	Time required
1	Facing & centering	Lathe	45 min
2	long drilling	Lathe	
3	Turning	Lathe	
4	Milling	Vertical milling	15 min
5	Drilling and reaming	Radial drilling	20 min
6	Tapping		
7	Reaming		
8	Heat treatment		
9	Grinding	Grinding	40 min

Table 5.15 Process Sheet for Top Line Shaft

The cost calculation for Top Line Shaft by proposed "Modified Activity Based Costing method", "ABC method" at 60% facility utilization and existing "percentage mark-up on material cost" method is presented in Table 5.16. The cost of different activities for proposed method and ABC method at 60% utilization is taken from Table 5.14. The cost of holding material in store is dependent on it's average stay in store. The average stay of material in store is calculated from the ledger data shown in Table 5.17. The average stay of the material in the store is calculated to be 60.27 days.

Elements of Cost	Existing Method	ABC Method @ 60% Utilizn.		Proposed Method	
Length of material				0.74	
Cost of 1 meter material length				159.30	
Cost of material	**118.04**		**118.04**		**118.04**
Cost of issue			**119.45**		**79.63**
Cost of holding material in store			**3.52**		**3.52**
Cost of purchase			**193.83**		**109.60**
Cost of lathe m/c		61.76		37.06	
Cost of vertical milling m/c		13.52		8.11	
Cost of radial drilling m/c		23.28		13.97	
Cost of grinding m/c		53.24		31.94	
Cost of direct labor		76.87		46.12	
Total cost of machining			**228.66**		**137.20**
No of handling				4.00	
Cost of handling			**207.28**		**124.23**
Percentage added for cost calculation	**20.00**				
Total cost of component	**141.65**		**870.78**		**572.23**
Percentage difference			514.74		303.98

Table 5.16 Cost calculation for Top Line Shaft (Rs. / unit)

Date	Receipt	Issue	Balance	Days diff.	Total inventory
01/04/97			13.60	4.00	54.40
05/04/97	2.00		15.60	10.00	156.00
15/04/97		0.30	15.30	3.00	45.90
18/04/97		1.20	14.10	6.00	84.60
24/04/97		0.90	13.20	8.00	105.60
02/05/97		1.00	12.20	1.00	12.20
03/05/97		3.40	8.80	11.00	96.80
14/05/97		1.50	7.30	11.00	80.30
25/05/97		0.40	6.90	21.00	144.90
15/06/97		0.80	6.10	3.00	18.30
18/06/97	2.50		8.60	4.00	34.40
22/06/97		2.20	6.40	4.00	25.60
26/06/97		0.90	5.50	4.00	22.00
30/06/97		1.70	3.80	4.00	15.20
04/07/97		0.70	3.10	0.00	0.00
04/07/97	2.20		5.30	9.00	47.70
13/07/97	2.00		7.30	2.00	14.60
15/07/97		1.20	6.10	3.00	18.30
18/07/97		0.50	5.60	7.00	39.20
25/07/97		0.30	5.30	8.00	42.40
02/08/97		1.30	4.00	3.00	12.00
05/08/97	5.40		9.40	2.00	18.80
07/08/97		1.00	8.40	5.00	42.00
12/08/97		0.60	7.80	3.00	23.40
15/08/97	4.00		11.80	7.00	82.60
22/08/97		0.80	11.00	10.00	110.00
01/09/97		0.60	10.40	4.00	41.60
05/09/97		1.80	8.60	2.00	17.20
07/09/97		0.30	8.30	5.00	41.50
12/09/97		1.50	6.80	9.00	61.20
21/09/97		1.00	5.80	9.00	52.20
30/09/97			5.80		0.00

Table 5.17 Receipts and issues of SS 316 Φ 20 mm bar

From Table 5.17

Total issues made =25.90 Mtrs. (Total of column 3) (5.1)

Cost per meter = Rs. 159.30 (5.2)

By (5.1) and (5.2)

Value of issues = Rs. 4,125.87 (5.3)

Total days =182.00 days (Difference between 1/4/97 and 30/9/97) (5.4)
Total of last column =1,560.90 (5.5)

As per equation 3.1
Avg. inventory per day =8.58 Mtrs. (5.6)

Avg. holding per day = Rs. 1,366.22

As per Equation 3.3
Inventory turnover = 3.02 (5.7)

As per Equation 3.4
Average stay = 60.27 days

5.7.2 Cost Calculation for "Pump Housing for Single Screw Pump RNA 30"

Pump housing for single screw pump RNA 30 pump is a cast iron casting. This casting is purchased from vendor. Present rate of casting is Rs. 28 per Kg. Each casting weighs about 40 Kg. Thus the standard cost of casting is Rs. 1120.

The casting requires internal boring and milling on one of the end face. Internal boring is done on vertical boring machine and milling on vertical milling machine.

Sequence	Operation	Workstation	Time reqd.
1	Internal boring	vertical boring	30 min
2	face milling	vertical milling	20 min

Table 5.18 Route sheet for Pump Housing

Elements of Cost	Existing Method	ABC @ 60% Utilization		Proposed Method	
Std. Casting rate / Kg.				28.00	
Std. weight of casting				40.00	
Std. Cost of casting	**1,120.00**		**1,120.00**		**1,120.00**
Cost of receiving		119.45		79.63	
Cost of issuing		119.45		79.63	
Cost of receipt & issue			**238.89**		**159.26**
Cost of boring m/c		23.28		13.97	
Cost of face milling		17.85		10.71	
Cost of direct labor		32.03		19.22	
Total cost of machining			**73.16**		**43.89**
No of handling				2.00	
Cost of handling			**103.64**		**62.12**
Percentage added for Cost calculation	**50.00**				
Total cost	**1,680.00**		**1,535.69**		**1,385.27**
Percentage difference			-8.58		-17.54

Table 5.19 Cost calculation for Pump Housing (Rs. / unit)

5.7.3 Cost Calculation for "Rotor for Double Screw Pump RNA 40"

Rotor is a screw in the pump. It is made from stainless steel of grade SS 316. The size of the rotor for RNA 40 pump is ϕ 120 X 300 mm. The raw material is required to be processed on two different workstations.

Sequence	Operation	Workstation	Time reqd.
1	Screw making	SPM	8 hrs.
2	Grinding	Grinding m/c	5 hrs.

Table 5.20 Route sheet for Rotor

The cost calculation for Rotor by proposed method, ABC method at 60% facility utilization and existing "percentage mark-up on material cost" method is presented in Table 5.21. The

cost of holding material in store is dependent on it's average stay in store. The average stay of material in store is calculated from the ledger data shown in Table 5.22. The average stay is calculated to be 86.49 days.

Elements of Cost	Existing Method	ABC Method 60% Utilization		Proposed Method	
Length of material				0.30	
Cost of 1 meter material length				41461.00	
Cost of material	**12438.30**		**12438.30**		12438.30
Cost of issue			**119.45**		79.63
Cost of holding material in store			**532.16**		532.98
Cost of purchase			**209.26**		118.33
Cost of SPM		658.76		395.26	
Cost of grinding		432.65		241.99	
Cost of direct labor		645.32		299.78	
Total cost of manufacturing			**1736.73**		937.03
No of handling				4.00	
Cost of handling			**319.62**		124.23
Std. Inspection time required (min)				20.00	
Cost of inspection			**26.64**		18.31
Percentage added for cost calculation	**30.00**				
Total cost of component	**16169.79**		**15382.15**		14248.81
Percentage difference			-4.87		-11.38

Table 5.21 Cost calculation for Rotor (Rs. / unit)

Date	Receipt	Issue	Balance	Days diff.	Total inv.
01/04/97			1.56	14.00	21.84
15/04/97		0.40	1.16	30.00	34.80
15/05/97	1.00		2.16	7.00	15.12
22/05/97		0.80	1.36	5.00	6.80
27/05/97		0.50	0.86	16.00	13.76
12/06/97		0.60	0.26	20.00	5.20
02/07/97	1.50		1.76	34.00	59.84
05/08/97		0.40	1.36	56.00	76.16
30/09/97			1.36		

Table 5.22 Receipts and issues of SS 316 Φ 120 mm bar

Sum of last column . =233.52
Total days =182.00
By equation (3.1)
Avg. inventory per day =1.28 Mtrs.

Cost per meter = Rs. 41,461.00
Avg. holding per day = Rs. 53,197.65

Total issues made = 2.70 Mtrs
Value of issues = Rs. 111,944.70

By equation (3.3)
Inventory turnover = 2.10

By equation (3.4)
Average stay = **86.49**

5.8 Comparison of Components' Cost by Three Methods

Now we compare the cost of three components as obtained by existing "percentage mark-up on material" method, ABC method and proposed Modified Activity Based Costing method. The comparison is presented in Table 5.23.

Component	Existing method	ABC method at 60% utilization	Proposed method
Top line shaft	141.65	870.78 (514.74)	572.23 (303.98)
Pump housing	1680.00	1535.69 (-8.58)	1385.27 (-17.54)
Rotor	16169.79	15382.15 (-4.87)	14248.81 (-11.88)

Table 5.23 Comparison of cost in Rs../ unit and
(% difference vis-a-vis existing method)

ABC method of costing adds idle time cost to the product hence increases the cost of product when there is idle capacity during the period. The figures in Table 5.23 shows that in all the three cases the cost computed by ABC method is higher than the cost computed by the proposed method. The cost by ABC method for Top Line Shaft is about 60% higher than the

cost calculated by proposed method. The change in cost of other two components are not severe but are significant. The "percentage mark-up on material" method used, does not account for different resources required while production proceeds. The Modified Activity Based Costing method calculates the cost as ABC method but does not add idle capacity cost to the product. The distortion in components' cost (percentage distortion is given in brackets) is large in Top line shaft, whereas the distortion is small in other two components. The primary reason is, Top line shaft requires small amount of material cost and "percentage mark-up on material" method could not account for manufacturing cost and other overheads. In the case of pump housing and rotor the material cost is high enough to allow "percentage mark-up on material" method to account for manufacturing cost and other overheads.

Chapter 6

CONCLUSIONS AND SCOPE FOR FURTHER STUDY

This work has reached the following conclusions.

(1) The use of modified activity based costing in calculating the components' cost gives us the systematic accumulation of costs to the product as shown in Table 5.14, Table 5.17, Table 5.19. It brings into the cost, any improvement in the processing of the product. A comparison of costing by "percentage mark-up on material cost" and costing by "modified activity based costing" has been made in the present work.

(2) The shift in product cost developed can be quite dramatic. For instance, it is found while calculating cost of "Top Line Shaft", (ref. Table 5.14) total cost of component by Modified Activity Based Costing is Rs. 572.23. The cost of same component when calculated by "percentage mark-up on material cost" is Rs. 141.65. The reason is that the cost of raw material used in Top Line Shaft is small Rs.118.04 (20.75%) as compared to cost of machining (24.12%) and overhead costs (55.12%). The small amount of material cost does not make percentage mark-up on material cost method to account for high machining cost and heavy overhead.

In the second example, the difference of cost arrived by Modified Activity Based Costing (Rs.1385.27) and existing "percentage mark-up on material cost" method (Rs. 1680.00) is 17.5% (ref. Table 5.17). In this example the material cost of casting is Rs. 1120.00, this is about 81% of total cost. Cost of machining is only 43.89 (3.16%) and assigned overhead cost is Rs. 221.38 (16%). The reason for smaller distortion in total cost in this example is high material cost. When "percentage mark-up on material cost" method is used, it accounts for overheads and machine cost more fairly in this case.

In the third example, the cost by Modified Activity Based Costing is calculated as Rs.13718.28 and the cost by "percentage mark-up on material cost" is calculated as Rs.16169.79. the difference is of 15.16% (ref. Table 5.19). The material cost of a Rotor is

Rs. 12438.30 that constitutes 87.29% of total cost obtained by Modified Activity Based Costing. Machining cost is only Rs. 937.03 (6.57%) of total cost and allocated overhead is 6.13% of total cost. Here again the reason for a lower distortion in total cost is the high material cost of a Rotor. When "percentage mark-up on material cost" method is used it accounts here fairly for overheads and machine cost.

(3) From the above three examples, we found that the machining cost and overhead cost per product are not proportional to the cost of material. Hence "percentage mark-up on material cost" method may produce incorrect cost data. The distortion is severe, when the material cost is small as seen in Top Line Shaft example. The Modified Activity Based Costing has capacity to present data in more systematic way. It identifies each of the activities performed and accumulates cost. The method is better suited to the manufacturing industry where range of products manufactured is large and the products require varied amount of resources. Modified Activity Based Costing enables us to accumulate costs as production proceeds. This method also supports variance analysis for direct unit level manufacturing costs to identify shifts from standard cost.

We have also computed cost of the same components by Activity Based Costing method when the plant is running at about 60% capacity utilization. Costing by Activity Based Costing method includes cost of idleness and hence increases the cost of components and does not facilitate costing as production proceeds i.e. on-line, as costing has to be done at the end of the year.

(4) The advantage of Modified Activity Based Costing is that it enables managers to take two types of action.

1. Change the product price that is, raise prices for products that make heavy demands on support resources and lower prices to more competitive levels for the products that require less support resources.
2. Reduce resource consumption. This requires either a reduction in number of activities required to produce the product or the amount of resource consumption per activity.

Reduction in resource consumption merely create excess capacity if so generated excess capacity is not used for other purpose. Modified Activity Based Costing does not take cost of idle capacity while costing a product. Thus it provides a stable product cost. It's use for on-line cost calculation points the profitability of the product and helps in setting prices as soon as product is produced.

Area For Further Study

- Implementation of Modified Activity Based Costing requires standard number of activities to be identified at the beginning of the period. Statistical methods of estimation through finding the distribution could be more useful in estimating the standard number of activities.

- This method does not separate variable costs from fixed costs while calculating product cost. If we separate these costs we can easily use this method for break even analysis.

- The usefulness of this method is limited to product costing; management may be interested in assigning a slice of idle time cost to the product as they foresee the expected idle time.

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